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THE

AMERICAN NATURALIST,

A

POPULAR ILLUSTRATED MAGAZINE

OF

NATURAL HISTORY.

EDITED BY

A. S. PACKARD, JR., E. S. MORSE, A. HYATT, AND F. W. PUTNAM.

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ERRATA, VOL. I.

Page 10, line 23, for *interval*, read *instance*.
" 14, " 14, " *fig.* 1, *plate* 2, read *fig.* 5, *plate* 1.
" 19, " 18, " *spattered*, read *spatter*.
" 24, " 32, " *Deleware*, read *Delaware*.
" 42, dele lines 11, 12.
" 43, line 22, for *superstícious*, read *superstitious*.
" 44, " 1, " *nutricious*, read *nutritious*.
" 54, " 7, " *State. When the dates are found*, read *State, the dates will be found;* on line 8, for *latter, cease*, read *latter case*.
" 71, " 5, " *Wavey*, read *Wavy*.
" 78, " 3, " *supernumary*, read *supernumerary;* on line 15, for *their*, read *its*.*
" 167, " 13, " *active*, read *actinic*.
" 431, " 34, " Fossil, read Fossorial.
" 491, " 9, " *leg*, read *hand;* dele line 25.
" 554, " 9, " *country*, read *county;* line 27, for *Scapiocrinus*, read *Scaphiocrinus;* line 40, for *Offil's*, read *Offiel's*.
" 555, " 20, " *Palæozoic localities*, read *Palæozoic formations*.
" 570, " 15, " *Pl.* 15, *fig.* 14, read *Pl.* 14, *fig.* 3.

*All errata ending with this line, were corrected in the later editions.

THE

AMERICAN NATURALIST.

Vol. 1.—MARCH, 1867.—No. 1.

INTRODUCTORY.

In laying before our readers this first number of a popular scientific monthly, we commence a publication in which we shall endeavor to meet the wants of all lovers of nature.

The rapidly increasing interest in the study of the various departments of Natural History invites the establishment of a journal which shall popularize the best results of scientific study, and thus serve as a medium between the teacher and the student, or, more properly, between the older and the younger student of nature.

If the reader, however slight his intercourse with nature may have been, shall find something in these pages to stimulate his zeal, and direct his mind to the right methods of investigation, and also teach him new facts concerning the haunts and habits of his favorites of the wood, the lake and the seashore, the great aim of this

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journal will be accomplished. Should it do no more than to bring naturalists, both young and old, into an active coöperation and sympathy, and promote good fellowship and amity between the great brotherhood of enthusiasts, as all true naturalists are, we shall gain a most important object. The value of our Magazine will depend more on its power to awaken the absorbing interest invariably excited by the contemplation of nature, and of illustrating the wisdom and goodness of the Creator, than on any adornment of style, or cunning devices of the artist.

We trust the Magazine will be equally welcome to the Farmer, Gardener and Artisan. We shall endeavor to point out the practical benefits resulting from the study of nature. The value of the study of the habits of insects, or Economic Entomology, the modes of breeding and development of animals and plants, and their distribution over the surface of the globe will be often discussed.

This is an utilitarian age, and all the theories now floating on the sea of science, all the stray facts not yet grouped in their proper places, besides the well digested facts which fill the treasury of knowledge, are all to be subordinated to the practical advantage as well as to the intellectual and moral elevation of man. As philosophers in seeking the truth for the truth's sake, let us not forget that our science will be ennobled by publishing those facts and principles which interest alike the philosopher and the day-laborer. The farmer and grazier are as much interested as the naturalist in all facts concerning the origin of

life and of specific forms, whether by direct creation, or by secondary laws as claimed by the followers of Lamarck or Darwin. In his work "On the Origin of Species," Darwin gathers many of his most important facts from the experience gained in the farmyard and garden, and all such facts are of practical value to the cattle breeder or horticulturalist. The studies of the astronomer in his observatory; the daily observation of the clouds and dew point; and of the barometer and thermometer, and the tracing of the course of storms interest alike the meteorologist, the farmer and the mariner.

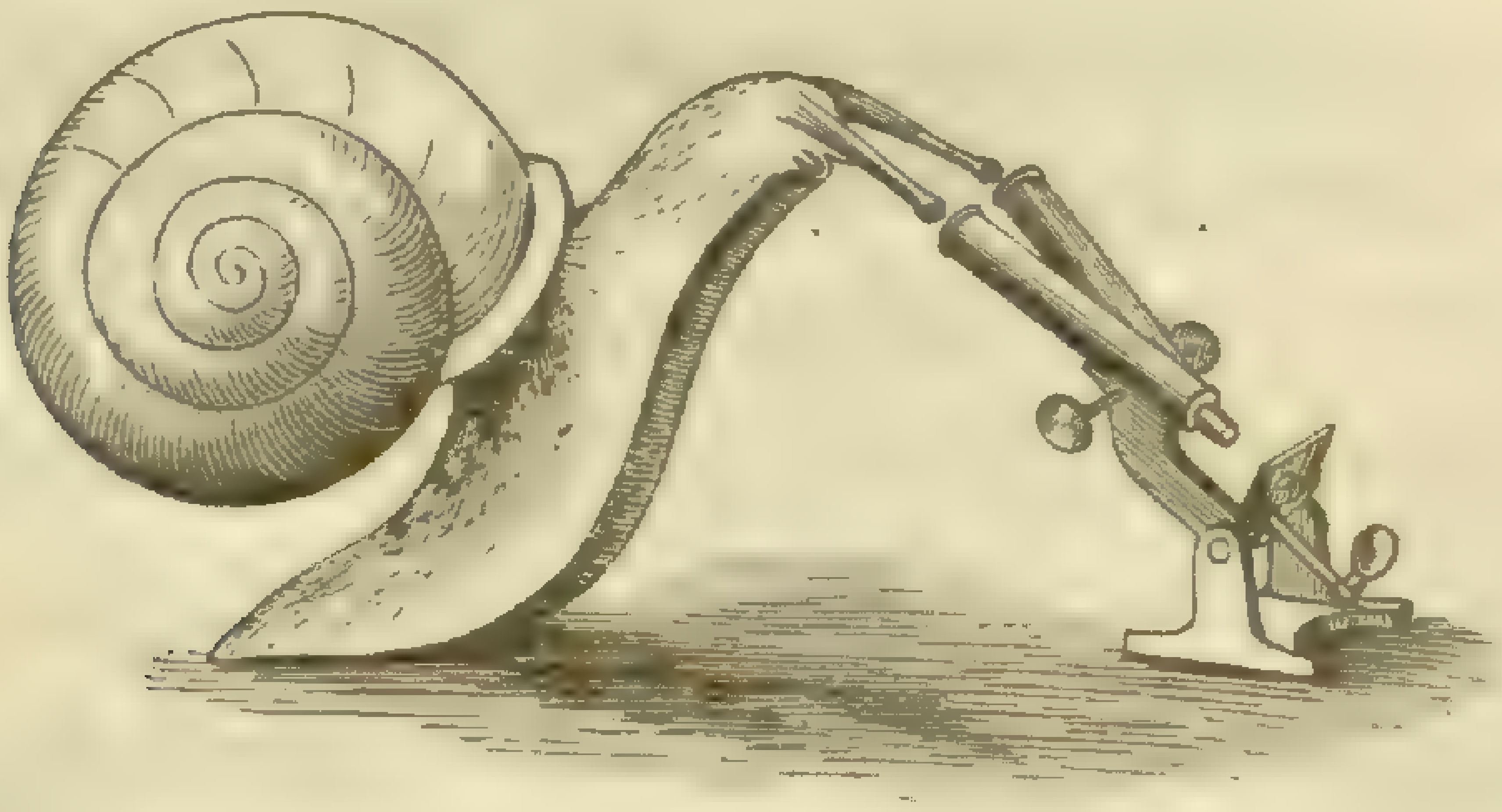
In our monthly calendar of the periodic returns of animals, farmers and gardeners will be warned of the attacks of insects injurious to crops. All inquiries respecting the attacks of such depredators will be answered in our columns, and modes of combating them be suggested.

As a medium between collectors, we trust the NATURALIST will be found of great use. Should the sportsman shoot a rare bird, or the insect-hunter capture a rare butterfly or beetle it may be here placed on record; or should the conchologist pick up a new shell which he is unable to identify from the means at his command, it will give us pleasure to aid in determining the name of his rarity; or, if unable ourselves, to place him in communication with specialists who have the requisite knowledge.

Such, then, shall be the leading object of the journal—to amuse the reader, perhaps decoy him within the temple of nature; and, if he be a willing student, instruct him in some of its mysteries.

The matter offered to our reader's acceptance will be mostly drawn from original sources. Occasionally we shall extract from the pages of our contemporaries. The most recent discoveries of general interest will be gleaned from the English, German, and French reviews and journals,—for science is cosmopolitan. Thus, following My Lord Bacon's bidding, we shall "prick in some flowers of that he hath learned abroad" for the better adornment of this our Naturalists' Companion and Solace.

The editorial responsibility seems great, and nothing but the boundless wealth of nature spread out before us, the untiring good will of our scientific friends in contributing to our pages, and the promise of the kindly appreciation of the public, can be an excuse for our appearance, and for any apparent presumption in our bearing.



THE LAND SNAILS OF NEW ENGLAND.

PLATE 1.

BY E. S. MORSE.

We offer to our readers the first of a series of papers on the Land Snails of New England, with the intention of carefully figuring every species of land snail known to occur within the prescribed boundaries. We shall also give a general history of the group, mentioning the hiding places of different species, and whatever facts we may think of interest to the general reader.

Certainly a more unassuming subject could not well be studied, for aside from the soothing pleasure of lying down, dorsal region uppermost, in some secluded grove, and hunting for half a day among the decaying leaves, upturning the different layers of successive autumnal deposits of withered foliage, even as the geologist throws open the different pages of the "Great Stone Book," the earth's crust, in quest of material for study,—aside from this quieting pursuit, we have no stirring incidents in their life to contemplate, no frantic hops, skips, and jumps of the insect tribe, no terrible bites to dread, or poisonous stings to shrink from, no enemy of our husbandry (except occasional injury from the garden slug) to baffle, no giant stride or rapid speed to wonder at; for the snail is proverbially slow in every respect. When disturbed, it does not, like many other animals, struggle violently to escape, but ceases motion, or quietly withdraws itself within its shell. Even the heart, which in higher animals, when agitated, pulsates with increasing energy, in the snail under similar excitement, throbs with a slower motion. And yet

we do believe that the careful study of a common snail will reveal the wonders of God's Providence in as forcible a manner as the history of the higher forms of animal life. Before presenting an account of the different species of land snails to be met with in New England, we must first learn something about the habits and anatomy of the group in general. Land Snails are universally distributed throughout the world, occurring under stones in open pastures, beneath the dead leaves and prostrate trees of the forest, in the interstices of bark, clinging to shrubs and spears of grass, lurking under damp moss, and occupying other positions of a similar nature. As they are dependant on the presence of a certain degree of moisture for their perpetuation and increase, they are more abundant in warm and damp regions, and are therefore found in greater numbers on islands, while in dry and desert places they are scarcely known to occur.

The land snails attain their greatest size and beauty in the tropics; the species diminishing in number and size as we approach the poles. Certain South American species attain the length of six inches, and the young when first hatched from the egg (which is as large as that of a pigeon), is an inch long.

We turn however with relief from the gaudy colored shells of the Equator, to our more humble representatives of the North, both modest and unpretending in size and color. The species native to the United States are essentially inhabitants of the forest, and there, dwelling under the damp leaves in continual darkness, do we seek the material for our study.

Figures 9, 10, and 11, plate 1, represent the common large snail of our woods, the white lipped snail or *Helix albolabris*. This snail is distributed throughout all

the Northern and Western States, and is a fair type of the family. The body is quite soft, and spreads below into an oblong, flattened disk. This disk is called the "foot," and forms their only locomotive organ. By means of numerous minute muscles distributed closely along this flattened surface, they are enabled to creep along, at times with an almost imperceptible motion, gliding smoothly over the roughest substances, ascending branches, and even burrowing in the ground. When we consider this sluggish, and too often despised snail, without legs, fins, or wings, and yet performing the important function of locomotion with as much certainty and ease as animals more highly endowed, we cannot but admire the versatility of the Great Creative mind in the various complete provisions made for the locomotion of all these humbler animals. During progression, the disk, or surface upon which they crawl, secretes a slimy, or viscid substance, which greatly facilitates their exertions, and they can often be traced to their hiding places, by following the silvery trail, which all snails leave behind, in their peregrinations. The English gardener, annoyed as he is by the depredations of certain species of snails, which nip the tender buds, and even devour the leaves of his plants, frustrates their destructive raids by encircling the plants with an earth work of dry sand; or better still, ashes. The snail, in attempting to pass this barrier, becomes completely entangled with the particles of sand adhering to its slimy body. Now, any irritation of this nature causes the snail to pour out this slime, or mucus, from all parts of the body, as can be easily proved by irritating the snail with the point of a stick, when shortly a ball of mucus will be formed on the stick, and the point finally rendered smooth. This provision to guard against such conditions, fairly ex-

hausts the snail in its attempts to pass the barrier, for the more abundant the secretion, the greater the entanglement, and finally the snail dies from exhaustion. Protections of this kind would be of no use in rainy weather, as the sand adheres together, and the snail can then pass over it very easily.

Certain species of slugs (Fig. 13, Plate 1), that is, snails having no coiled shell, but alike in other respects, have the singular power of lowering themselves from some projecting point by means of this mucus, which they throw off from the posterior end of the creeping disk; and we have seen a common slug (a species occurring abundantly in our garden and fields), lower itself from the back of a high chair to the floor. They have no power, however, like the spider, to retrace their course. They will often hang suspended in mid air for sometime, apparently for no other purpose than to enjoy themselves.

The snail has no power to leave its shell as many suppose. The shell is as much a part of the animal, as is the hard crust of a beetle a component part of the insect. And not only this, the snail is attached to the shell by a permanent muscular attachment, and cannot be withdrawn from it alive. In order to clean the shell of its contents, it is customary to scald it in boiling water, when the muscular attachment becomes separated from the shell, and the soft parts can be easily removed. The finding of empty shells in the woods, has oftentimes been cited as a proof that the snail can leave its shell, and the occurrence of certain species of snails which have no visible shell, has served to strengthen a belief in this error. When the creature dies, the soft perishable parts are soon decomposed, or else devoured by insects, leaving the more enduring shell as a monument to its memory. On the ap-

proach of winter, or the continuance of a severe drought, the snail hybernates, that is, it ceases to feed, and withdraws itself far within its shell, leaving at the same time several barriers within the aperture of the shell, composed of the mucous secretions of the animal. In this condition it remains, motionless and apparently lifeless. The mode of forming these partitions is quite curious, and will interest the observer. As the snail withdraws within the shell it inspires a certain quantity of air; the creeping disk, and the parts of the animal bordering the aperture of the shell pour out a certain quantity of mucus, which stretches completely across the aperture of the shell. This soon hardens, and the snail by expiring most of the air in its lungs, and thus reducing its bulk, retires still farther within its shell, and again forms a barrier similar to the one just formed, and oftentimes several partitions are formed in this way, one behind the other, affording a complete protection against the inroads of cold and water, and apparently of heat as well, since they always do this when confined in a dry or hot place. In a certain foreign species, this partition partakes of a calcareous nature, and thus affords a more enduring barrier. In the spring time the snail resumes its activity, the barriers are forced through by the tail, and frequently the snail devours them, as if famishing after its long continued fast.

All species of land snails with few exceptions, are oviparous; that is, the young are hatched from eggs laid by the parent. The sexes are united in each individual, though the mutual union of two individuals is necessary to fertilize the eggs. They lay from fifty to one hundred eggs at a time. The eggs of most species are very small, white in color, and resemble homœopathic pills. If the conditions are favorable, the young issue from the eggs in

the course of two or three weeks, furnished with a shell composed of one whorl and a half. The shell is increased in size by the addition of calcareous matter round the margin of the aperture. The successive lines of growth can be easily traced on the shells of most species. They attain their complete growth in from one, to two years. The number of eggs produced by an individual varies in proportion to the greater or less protection afforded to the animal; thus in the common slug, *Limax*, and allied genera, having no exterior shell into which they may withdraw in times of danger, the number of eggs produced is much greater, and according to Dr. Leach, who kept two specimens of the common garden slug in confinement, seven hundred and eighty six eggs were laid in one year.

The vitality which the snail's eggs possess surpasses belief. Certain French naturalists assert that they have been so completely dried, as to be friable between the fingers. In this dried condition they have been kept for a long time, and yet a single hour's exposure to humidity and warmth, has been sufficient to restore them to their original form and elasticity. They have been dried in a furnace eight successive times, until they were reduced to an almost invisible minuteness, yet in every interval have they regained their original bulk in a moist situation. In all these instances the young have been developed, in the same manner as other eggs not subjected to this experiment. (Binney.) This wonderful vitality extends to the snail in all stages of its existance. We have seen certain species frozen in solid blocks of ice, and yet regain their activity when subjected to the influences of warmth. Their dependence on moisture naturally places them in moist situations, yet we have seen certain species attached to leaves, where the sun had shed its scorching rays for

weeks, crisping the leaves, and baking the ground as dry as potter's ware, and yet these conditions not affecting in the least their vitality. They have been kept for years in pill boxes, and yet on subjecting them to moisture, have crawled about appearing as well as ever. In "Woodward's Manual of Shells" is the following, chronicled by Dr. Baird, regarding the resuscitation of a desert snail. "This individual was fixed to a tablet in the British Museum on the 25th of March, 1846, and on March 7th, 1850, it was observed that he must have come out of his shell in the interval (as the paper had been discolored, apparently in his attempts to get away) but finding escape impossible, had again retired, closing his aperture with the usual glistening film; this led to his immersion in tepid water and marvellous recovery." The power possessed by the snail to reproduce certain portions of its body removed by violence, has long attracted the attention of Zoölogists. The horns, or tentacles, and even portions of the head have been cut away, and in due course of time these lost parts have been restored by a new growth. The whole head has been cut away, and though in many cases terminating the life of the victim, yet in some instances the parts removed have been fully restored. This seems the more wonderful when we consider the complicated character of the head and mouth. The shell may be broken, and even portions of it removed, and yet after a certain lapse of time the injured parts will be repaired by a deposition of shelly matter at the fractured parts. We have thus far examined briefly the general history of the snail. Let us now proceed to examine more minutely its anatomical characters.

Figure 10, on plate 1, represents the common large snail of the woods, the white lipped Helix, or technically

speaking, *Helix albolabris.* It is represented as crawling, and consequently extended fully from the shell. The two larger and two smaller "horns" projecting from the head, are respectively called the upper or superior, and lower or inferior tentacles. The superior tentacles are the longest, and stand uppermost; at the tips of these are found the eyes, little black specks, though large enough to be distinctly visible. The eyes are very simple in structure, and probably serve no important use, as the snail in progression, appears to depend entirely on the tentacles as feelers to guide the way. While they crawl, the tentacles are continually in motion, and the tips oftentimes come in contact with various objects on the way. If the eyes were capable of ordinary vision, this occasional contact of the tentacles would be avoided.

That the sense of smell is enjoyed by the snail has long been known, since they will oftentimes travel some distance in quest of food for which they have a particular fondness; the exact seat of this sense, however, has long been a disputed question. An eminent French Naturalist believes it to be seated at the extreme tip of the larger tentacles. A magnified drawing is given (Fig. 1, Plate 1,) of the end of the larger tentacles to show the position of the nerves supposed to be the nerves of smell, or the olfactory nerves, (*o*, Fig. 1,) these are seen as minute threads or branches terminating at the extreme end of the bulb-like tentacle. In this figure the eye is also seen with the optic nerve. (*e.* eye, *op.* optic nerve.) The larger tentacles are retractible, that is, they have the power of withdrawing within the head, the eyes disappearing first, as a glove finger disappears as it is withdrawn over the hand, turning the glove wrong side out. The smaller, or inferior tentacles, have not this power of with-

drawing within the head, but remain always extended. When the snail is feeding, it is very curious to observe the listless appearance of the larger tentacles. A dog, or a cat, when feeding will often partially close the eyes and appear drowsy. It would seem that similar sensations are experienced by the snail, for while feeding, the tentacles are partially drawn within the head and hang downward, as if the delights of feeding were altogether too engrossing to mind the lax state of the tentacles. When on the trail, however, the tentacles are thrust out to their greatest length, perfectly rigid, and give an appearance of alertness to the snail that it does not possess. Just beneath the lower tentacles the mouth is situated, having on the upper lip a crescent shaped jaw, (Fig. 7, Plate 1,) of a heavy texture, and quite hard. In some species of snails, the jaw is quite smooth, and has a slight projection on the cutting edge. In other species, the larger ones especially, the jaw is ribbed, and the cutting edge is notched and jagged like so many teeth as it were. In fact this jaw answers all the purposes of an upper set of teeth, for it is capable of biting through the thick leaves of a cabbage; as can be easily proved, by keeping a snail in confinement, and feeding it on cabbage or lettuce, of which it is very fond. When feeding, all the movements of the mouth are plainly visible, and not only can the little semi-circular cuts of the jaw on the leaf be seen, but while feeding the nipping sound of the bite can be distinctly heard. The larger snails are also very fond of flour paste, and while luxuriating in this simple diet each white mouthful can be easily traced in its course, from the mouth to the stomach, owing to the translucency of the snail's body. The lower lip is not furnished with a plate, but just within the mouth there is

spread a membrane, very appropriately called the *tongue*, or lingual membrane, as the snail uses it in lapping its food. This membrane is quite long and broad, and is covered with minute silicious denticles, or teeth, as they are called.

As an object for the microscope, it will repay one the trouble attendant on dissecting this membrane from the mouth of a snail. A magnified figure of the entire tongue is given on plate 1, fig. 6. Nothing can exceed the beauty and regularity in the form and arrangement of the denticles. These are pointed and turn backwards, thus forming a series of little claws and hooks, and are admirably adapted to perform the rasping function allotted to them; fig. 1, plate 2, gives a side view of a few of these teeth to show their hooked character. The number of denticles on the tongue is very great. Some species, the white-lipped Helix, for instance, having nearly twelve thousand denticles. It is difficult to conceive the minuteness of these particles, when we consider that the membrane on which they rest is not a quarter of an inch long, and only half as wide. The denticles are arranged in regular longitudinal and transverse rows. Figure 3, plate 1, represents two transverse rows of these denticles, and fig. 4 a central tooth, with lateral teeth more highly magnified to show their form. It will be noticed that the central denticles are symmetrical in form, having the two sides alike, while those on each side are not symmetrical. In illustrating the dentition of a species, it is only necessary to draw one half of one transverse row, including the central denticle, at the same time mentioning the number of transverse rows on the membrane; thus in the white-lipped Helix, a specimen of which we examined, we found eighty-nine denticles in a transverse row, that is, one

central denticle, flanked on each side by forty-four lateral denticles. There were one hundred and twenty-three transverse rows, making the whole number of denticles on the membrane ten thousand nine hundred and forty-seven, or, about eleven thousand. The form, and number of denticles in each species vary, as we shall show hereafter.

In looking for the breathing hole of the snail, those ignorant of its structure might refer to the mouth as the opening through which it inhaled air. It is a common idea that insects breathe through the mouth, because the higher animals do so. Now insects breathe through little perforations on the sides of their body, and the snail has an aperture on the right side of its body, just within the aperture of the shell, through which it breathes. This aperture can be plainly seen in the mantle or skin which fills the mouth of the shell, (Fig. 11, a, Plate 1) by turning the snail over. The lung is a simple cavity, lined with a net work of blood vessels. The blood is a bluish colored fluid, and is circulated through the body and lung, by a pulsating heart composed of two chambers, an auricle and a ventricle, separated by a double valve. The heart's pulsations can be distinctly seen through the lower part of the translucent shell of many species. Fig. 2, *h*, plate 1, represents the heart situated in the pulmonary cavity. In this figure the lung is represented as turned back from the animal, exposing the heart. Fig. 12 represents the heart and lung of a common slug. It would lead us too deep into the anatomy of the snail, were we to indicate the character and position of the liver, kidney, and many other organs which combine to make up the complicated structure of our apparently simple snail. Suffice it to say, that however insignificant many of the lower

animals appear to the common observer, yet a description of their minute anatomy alone would form many a chapter of surpassing interest to those who delight in contemplating the perfection of God's works.

In our next paper we shall commence the description of the different species of land snails to be found in New England.

EXPLANATION OF PLATE 1.

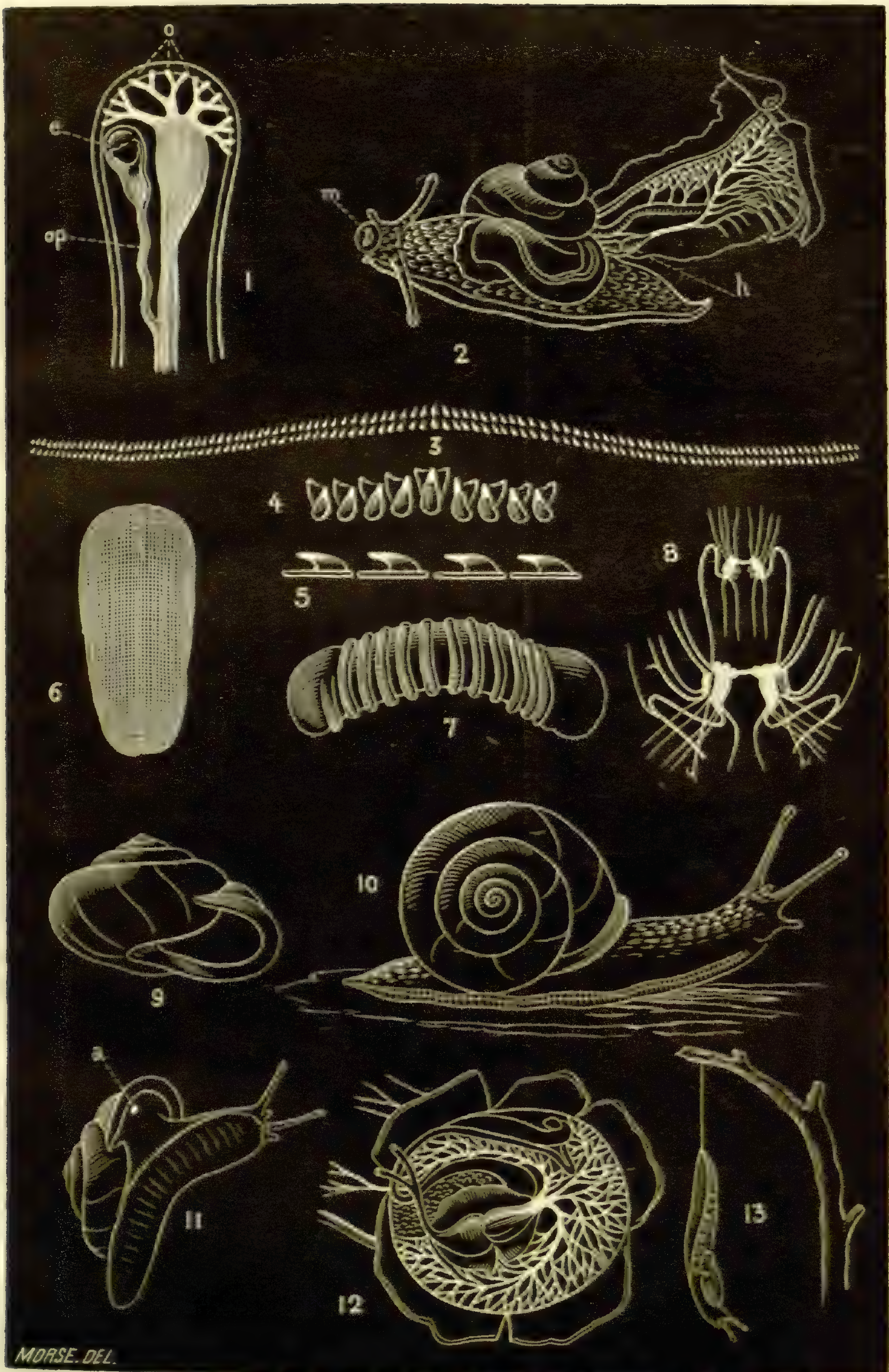
Fig. 1. Magnified view of superior tentacle of a snail. *op.* optic nerve; *e.* eye; *o.* olfactory nerves.
Fig. 2. *Helix albolabris*, with shell removed and mantle thrown back, showing lung and heart. *m.* mouth; *h.* heart.
Fig. 3. One row of teeth from the same, magnified.
Fig. 4. A portion of one row of teeth from the same, highly magnified.
Fig. 5. Side view of teeth of the same.
Fig. 6. Entire tongue of same, enlarged.
Fig. 7. Jaw of same, magnified.
Fig. 8. Nerve centres of *Helix albolabris*.
Fig. 9. Shell of *Helix albolabris*.
Fig. 10. *Helix albolabris* crawling.
Fig. 11. " " turned back, showing orifice to lung, *a*.
Fig. 12. Lung and heart of Garden Slug, *Limax flavus*.
Fig. 13. Slug suspended from twig.

THE VOLCANO OF KILAUEA, HAWAIIAN ISLANDS, IN 1864-65.

PLATE 2.

BY W. T. BRIGHAM.

Soon after one o'clock we came upon the brink of the great crater. From below us steam and vapor rose in a sluggish column, but we saw no fire and heard no noise: the conflagration had, as it were, left nothing but smoking ruins to mark the scene of its triumph. The deep plain before us was surrounded with steep rock-walls, from



MORSE ON THE LAND SNAILS OF NEW ENGLAND.

three to seven hundred feet high, and nearly nine miles in circuit. Boston could easily be accommodated within this crater, and Vesuvius would not much more than fill it. The whole circuit of the walls is much broken and interrupted, and we rode along over several large cracks, one of which opened about a year since (in 1863). Some are concentric, and others radial, and all along the edges of the abyss are fumaroles from which issue clouds of steam, not as at the Geysers of California, with great noise, but gently as a quiet respectable teakettle pours out its vaporous offering. The steam had no smell of sulphur, and ferns were growing luxuriantly over the openings, while the condensing vapor formed pools of sweet water, the only source of drinking water in this fire-searched region.

When we reached the north-western part of the crater, we found on our left a ridge of reddish earth, from which steam and strong sulphurous fumes poured in many places. This was the western Sulphur Bank, and in its cracks were forming the most beautifully delicate crystals of sulphur, almost mosslike; and here and there a blue crystal of sulphate of copper, and greenish masses of sulphate of iron. The earth, which is formed by the decomposition of the lava, was quite hot, and we found some natives cooking fern stalks in the steam.

While we were examining the sulphur deposits, our men came up with our blankets, and we at once engaged an old kanaka who lived near by, to guide us down into the crater. Two other kanakas went with us to carry water and bring back specimens. The descent was at first quite steep, down the hard grey walls; and then the path wound along on broken shelves, under a grand precipice two or three hundred feet high, quite perpendicular, and

looking as if built of regular blocks of stone. Small shrubs grew by the way, and we picked berries (vaccinium) in abundance. At last after a rapid descent on a steep gravelly bank, we stepped into the fresh black lava of the crater floor. This floor looked quite smooth and level from above, but we found it was very rough and uneven. The fresh lava we first met had broken up during the last winter and overflowed all the end of Kilauea, and it was piled in twisted masses and broken slabs and bubbles. Its surface was covered with a thin nitrous crust, which crumbled beneath our tread, sounding as hard-frozen snow does on a frosty morning, and thus a distinct path had been worn to Lua Pélé or the great fire-pit which is at the south-western end of the crater proper.

Half a mile of such travelling and we came to a wall of hard trachyte, quite unlike the lava of the floor, which seems to have been floated up here from the walls below. The great blocks which compose it are said to change their position from time to time as the floor rises and cracks. Fissures of all sizes were common, and from many of them steam issued changing the black lava to a reddish hue. The action of vapors and gases had produced fragments of all shades and colors, some so metallic as to closely resemble gold, others red, violet, green, etc. Now and then we broke through the thin crust of a bubble, and although we could not repress a momentary shudder as we thought of what might be the result of a fall into the regions beneath, the stirring interest of the place drove away considerations of personal danger.

After two miles we came to a fearful crack about three or four feet wide, and so deep we could not see the bottom, but still there was no sound that we did not make ourselves, and we could not see any fire. I was certainly

disappointed in this, for I remembered the accounts of those who had seen all this plain in a melted state. As we came near the Lua Pélé, however, we found a black cone some twenty-five feet high, with a bright spot at its summit. There was fire at last, but we pushed on over the loose slabs, and through the steam, until suddenly we stood on the brink of the lake of lava some seven hundred feet long, five or six hundred feet wide, and perhaps thirty feet below us. The surface was covered with a dark crust, broken around the edges where the thick blood-like mass surged against its banks with a dull sullen roar. The sulphurous vapors which rose from its surface were blown away by the wind, so that we could approach the very brink on the windward side, but the heat was so great that we had to hold our hands before our faces. The walls on which we stood and where we intended to sleep, were thickly covered with Pélé's hair* which we saw constantly forming. The drops of lava spattered out as the waves dash against the walls, drawing after them a thread, or two drops spin out a thread between them like the finest "spun glass," and these broken threads are caught against the rough points of the cliffs and form a thick coating.

Occasionally a crack would open in the surface of the lake, and the white-hot lava boil up through it in several places for a few minutes, and then turning red, and cooling rapidly, become black as before. A current would often set in towards the banks, and cake after cake breaking off from the crust be drawn in, causing a violent bubbling and spattering; and then this would cease, or run in another direction, but always from the centre to the edge.

As it grew dark we were very tired, having travelled

*Pélé was the Hawaiian Goddess of fire whose home was in Kilauea.

since six o'clock in the morning, and hoping to wake up in the night when the fires would be more brilliant, we rolled ourselves up in our blankets, and, with our guides near by, went to sleep a few rods from the crater. At nine o'clock I waked, and as the night air was quite cold, moved to the very edge of the crater to warm myself, and enjoy the magnificent fireworks. The moon was up and almost full, but her light was dull beside the fires of Pélé. Finding the place quite comfortable, I picked out a soft rock for a pillow, and went to sleep again. At twelve I awaked with a start and found myself in a shower of fiery drops, some of which were burning my blanket. I shook myself and jumped back, looking at my watch to note the time, and then stood gazing at the strange scene some time before I thought of my companions. The whole surface of the lake had risen several feet, and was violently boiling and dashing against the banks, throwing the white-hot spray some sixty feet over the upper banks, causing the providential rain that awakened me to see this grand display. There was no thundering or bellowing, only the splash of the waves as they fell back, or the rattling of the cooled drops on the upper banks. The light was so intense as to be almost painful, as the crust had wholly melted, and brilliant fountains of fire covered the surface.

When I could think of anything else, I called the others, but only succeeded in awakening the guides, and just then a drop of lava came plump into a greasy newspaper we brought our supper in, and it blazed up suddenly, to the dismay of our guides, who, thinking that the volcano had broken out at our feet, at once fled to a safe distance. Failing to arouse them with my voice, I threw several handfuls of gravel at the sleepers but without effect, and I had to climb down, almost blinded by gazing at the fire,

BRIGHAM ON THE CRATER OF KILAUEA IN 1864-5.

and shake them roughly. When they at last reached the edge the action had greatly diminished, and in a few minutes more the dark crust covered the central portion, extending rapidly to the sides, and after watching the last crack close, we all went to sleep again. I was glad to see such distinct flames, as their existence has been denied in volcanoes. They were bluish-green, and shot up in tongues or wide sheets a foot long.

In the morning we found it very misty, and the mist soon turned to rain. We went to the cone we had seen the night before, and climbing its spattered sides, looked into the hole in the top. We could see that it was white-hot within, but we were unable to excite it, although we threw in pieces of scoria, and poked it with our sticks. On the other side of the path was a cone, long and irregular, with many pinnacles from which much smoke issued. We got quite wet in climbing up the bank, and at seven o'clock were eating our breakfast in the grass house on the upper ledge.

A year afterwards I again went to Kilauea. Many changes had taken place. Lua Pélé was much larger, and two new pools had opened during the winter. The place where I slept last August had melted away, and I was obliged to camp in another place. The superstitions of the natives have always been greatly excited while in this crater, and I saw many reasons for it. As we walked towards the bright lake about dusk, I thought I saw two or three men walking to and fro on the brink, and asked my guide what strangers had been down into the crater. "Aole haole aka akua paha"! (It is no stranger but perhaps a spirit) said the old man, so solemnly that I was startled. As the steam moved in the wind, it opened and brought to view the black cliffs beyond, and this we had taken for

moving men, not reflecting that the forms must have been gigantic at such a distance from us. In ancient times the bodies of the chiefs who worshipped Pélé were committed to this pit.

As we were sitting on the brink, a shrill shriek broke through the night air. We could see the black walls of the crater all around us, and between us and the pathway leading out, a line of watchfires, and I was quite as much impressed as my natives with the direful stories they had been telling me. The shriek was repeated, and it was evidently the utterance of a human being in great agony. Lighting the lantern we had brought for any emergency, we went slowly towards the place, until the shriek was uttered at our very feet. We hastily examined the cracks and called, but there was no answer, and all was still. We looked everywhere, finding no one, and turned to go back, thinking some poor kanaka, venturing down in the dark, had fallen into some crack, and at last died.

We had gone but a few rods when the shriek was repeated. The natives clung to me in mortal terror, but I insisted on going back, and placing the lantern on a rock, we sat down to await developments; it seemed as though the question, "are there any spirits present?" was quite superfluous. We sat more than five minutes in silence, and I could feel the poor fellows tremble as they sat close up to me. Then the shriek was repeated, but we saw the spirit that made it,—a jet of steam—and my boys were encouraged.

The smaller lakes were close to the surface, and I could put my stick into the melted mass. It was strange to see how soon the lava cooled on the surface. As soon as it had ceased bubbling, I threw a small perfectly dry stick of wood into it, and it was more than fifteen minutes before it smoked much.

This last visit was in August, 1865, and ever since that time the action in the crater has been increasing, until the floor of this vast pit has risen nearly a hundred feet, and at times has been quite inaccessible, owing to the streams of lava flowing over the surface.

THE FOSSIL REPTILES OF NEW JERSEY.

BY PROF. E. D. COPE.

In traversing New Jersey from north west to south east, we pass over rocks and soils which have been deposited by an ocean whose coast has constantly moved toward the south east, until its position has become that now forming the boundaries of the State. Hence the material now nearest the coast is that last laid down, and as we proceed towards the north west, the beds are a sediment of successively older and older date. Not, however, till we reach the red sandstone of the line of New Brunswick, do we meet with formations which have suffered a sufficient amount of pressure and heating to convert them into stone to any great extent. The gradual recession of the ocean has been occasioned by a similarly regular elevation of the land in its rear. This elevation was however, only gradual during portions of the time; between such elevations existed long periods of rest. For instance the red sandstone mentioned before was for a very long time within the shore of the ancient ocean. During that time beds were deposited outside of an older coast land, which subsiding later, were covered by newer beds, which include the remains of those creatures that have died near the

shore and been washed into the sea, or have died in the ocean. With a continued sinking, including now the red sandstone, the newer deposits reached in time the level of its summits; and during the subsequent and long continued rise, a succession of sea beaches gradually extended the area of the land to the south east. Abundant vegetation clothed the shores, which supported insect life and large herbivorous animals, which were in turn fed upon by smaller and larger carnivorous forms. The period during which the deeply buried strata at the side of the red sandstone was deposited, is called by geologists that of the Lower Cretaceous; while that which forms the surface resting upon the last, and extending from the red sandstone over nearly half the remainder of the state of New Jersey, is the Upper Cretaceous formation. During the deposition of the former, extensive beds were being laid down in various parts of the earth, especially western Europe, which entombed similar animal and vegetable types. With the Later Cretaceous of New Jersey also, corresponding strata were deposited in the far west of North America, and Europe, including in England the well known white chalk rock. At the close of this epoch, New Jersey, most probably, had accomplished in its south eastern section a very extended and considerable elevation, and at the same time vast changes in other regions of the earth caused a great change in the temperature; so great as to destroy all animal life then existing. It is also certain that the south eastern extremity of the region underwent a second gradual descent, and was again covered with water to a coast line running north east and south west, dividing the present land between the south western bend of the Deleware and the present coast line into two nearly equal areas. Then began again the deposi-

tion of beds, and the introduction of entirely new forms of animal life more like those of modern times. The period during which this deposit, so near the present coast line, was formed, as also many corresponding deposits in other regions of the earth, is called in geology, the Tertiary. Its beginning was the "morning of the sixth day" of the Mosaic record of the Creation. This great period, after having seen many changes, culminated in the creation of man. At this point history begins, and no extended geologic changes have taken place since. We have advanced six thousand years, or probably, considerably farther into the "seventh day" or period.

The beds of green marl were laid down during the upper Cretaceous period. At a suitable depth of water along the several ancient coasts, lived immense numbers of minute marine creatures, called *Foraminifera*, which inhabited delicate, almost microscopic shells, composed of numerous cells. After their death the chamber of the cells became filled with the fine mud formed of dissolved clay, oxide of iron and other substances, which are enumerated by Prof. G. H. Cook, in his valuable Report on the Geology of New Jersey. When the beds were raised, the drying, and other agencies brought to bear, decomposed the delicate shells, and left only the hardened mud as casts of their chambers. Hence the green marl now resembles gunpowder, deriving its peculiar color from the protoxide of iron.

The valuable properties of this marl, as a manure, no doubt depend on the products of the decomposition of the vegetables and animals formerly dwelling in the ocean or on the neighboring shores. The numerous fossiliferous beds, one or more of which are usually cut across by the diggings, have supplied in part this material. Most of

the animals found in these beds were bivalves, with numerous Brachiopoda and Cephalopoda, or Cuttle-fish. Of the unsymmetrical univalves, or Gasteropoda, comparatively few specimens occur in the Cretaceous marl of New Jersey.

Of Vertebrata, or those animals provided with a back bone, or vertebral column, numerous species, large and small, dwelt on the land and in the water. Their number has been so considerable, especially in the region opened by the diggings of the New Jersey Marl Company, as to materially affect the richness of the marl in phosphate of lime. Of cartilaginous vertebrates, such as the Sharks, we have found remains of the genera *Otodus*, *Lamna* and *Carcharodon*. Some of these were not only very numerous but attained a great size, and were of ferocious habits. There were also Saw-fishes closely allied to those of the present day. Fewer remains of the bony fishes, such as the Perch and Cod, have been procured from these pits; while in other neighborhoods Sword-fish and long fanged *Sphyræna* types have occurred.

In huge reptiles the region has been especially prolific. Through the care of Superintendent Voorhees, the remains of seven of the larger species have been exposed and preserved during the excavations. Four of these belonged to the group of Crocodiles; namely:—

Thoracosaurus Neocæsariensis DeKay; carnivorous.
Thoracosaurus obscurus Leidy; "
Bottosaurus Harlani Meyer; "
Macrosaurus lævis Owen; ?
Hyposaurus Rodgersi Owen; ?

These were probably dwellers by the shore, and devourers of the large fishes and of any luckless reptiles strolling on the beach. A gigantic precursor of the still

existing Lacertilia (Lizards) was probably whale-like in habit; and though not equalling these monsters in size was still formidable, attaining a length of thirty feet. It was probably in part also carnivorous. This huge reptile was called *Mosasaurus Mitchellii* by DeKay, and its remains are more numerous than any other, except those of the large Thoracosaurus.

Another group of animals, the *Dinosauria*, while approaching in some respects the mammals and birds, presented more of the features of the reptiles. Many of them were the giants of the land of the Cretaceous time, as well as of its waters. Those whose remains have been found in the Company's pits, are *Lælaps aquilunguis* Cope, which was carnivorous, and *Hadrosaurus Foulkii* Leidy, an herbivorous animal.

The last was the most bulky quadruped of the period yet known; a femur, or thigh bone, discovered near Haddonfield, measures nearly four feet in length. The animal is estimated by Professor Leidy to have been twenty-five feet long. The *Lælaps* has been found represented in the Company's pits, only by remains sufficient to ensure its identification, a few small pieces from the neighborhood of Freehold, described by Professor Leidy, being assignable to an allied, or doubtfully to the same genus. As the former constitute the most complete indication of any individual of a carnivorous Dinosaurian hitherto discovered considerable interest attaches to them. The great reptile, *Megalosaurus*, is known by more numerous fragments, but they have been gathered from many diffirent localities; *Dinodon* is known only from its teeth, and *Euscelosaurus*, of the South African beds, by a femur only.

The lightness and hollowness of the bones of the *Lælaps*

arrest the attention of one accustomed to the spongy, solid structure in the reptiles. This is especially true of the long bones of the hind limbs; those of the fore limbs have a considerably less medullary cavity. The length of the femur and tibia render it altogether probable that it was plantigrade, walking on the entire sole of the foot like the bear. They must also have been very much flexed under ordinary circumstances, since the indications derivable from two humeri, or arm bones, are, that the fore limbs were not more than one-third the length of the posterior pair. This relation, conjoined with the massive tail, points to a semi-erect position like that of the Kangaroos, while the lightness and strength of the great femur and tibia are altogether appropriate to great powers of leaping. The feet must have been elongate, whatever the form of the tarsi; the phalanges, or finger bones, were slender, nearly as much so as those of an eagle, while the great claws in which they terminated were relatively larger and more compressed than in the great birds of prey. There was no provision for the retractibility observed in the great carnivorous mammalia, but they were always equipped with sheaths and crooked points of bone. The toes may have been partially webbed, and it is not improbable that the hind legs may have occasionally been most efficient propellers of these animals along the coast margins of the Cretaceous sea.

The hind foot could not have been straightened in line with the tibia, owing to a most anomalous structure which has only been once before observed, and then in a species clearly referred to its type. The distal head of the fibula, or small bone of the leg, appears to have embraced and capped the tibia like an epiphysis, and to have given attachment to the bones of the tarsus, by a condyle directed

anteriorly. The object of this structure remains unexplained. The whole hind leg could not have been less than six feet, eight inches in length.

Fragments of the jaws indicate a face of very considerable length, showing shining saw-edged, knife-shaped teeth; but any nearer idea of the beast's expression cannot now be attained. If he were warm-blooded, as Prof. Owen supposes the Dinosauria to have been, he undoubtedly had more expression than his modern reptilian prototypes possess. He no doubt had the usual activity and vivacity which distinguishes the warm-blooded from the cold-blooded vertebrates.

We can, then, with some basis of probability imagine our monster carrying his eighteen feet of length on a leap, at least thirty feet through the air, with hind feet ready to strike his prey with fatal grasp, and his enormous weight to press it to the earth. Crocodiles and Gavials must have found their bony plates and ivory no safe defence, while the Hadrosaurus himself, if not too thick skinned, as in the Rhinoceros and its allies, furnished him with food, till some Dinosaurian jackalls dragged the refuse off to their swampy dens.

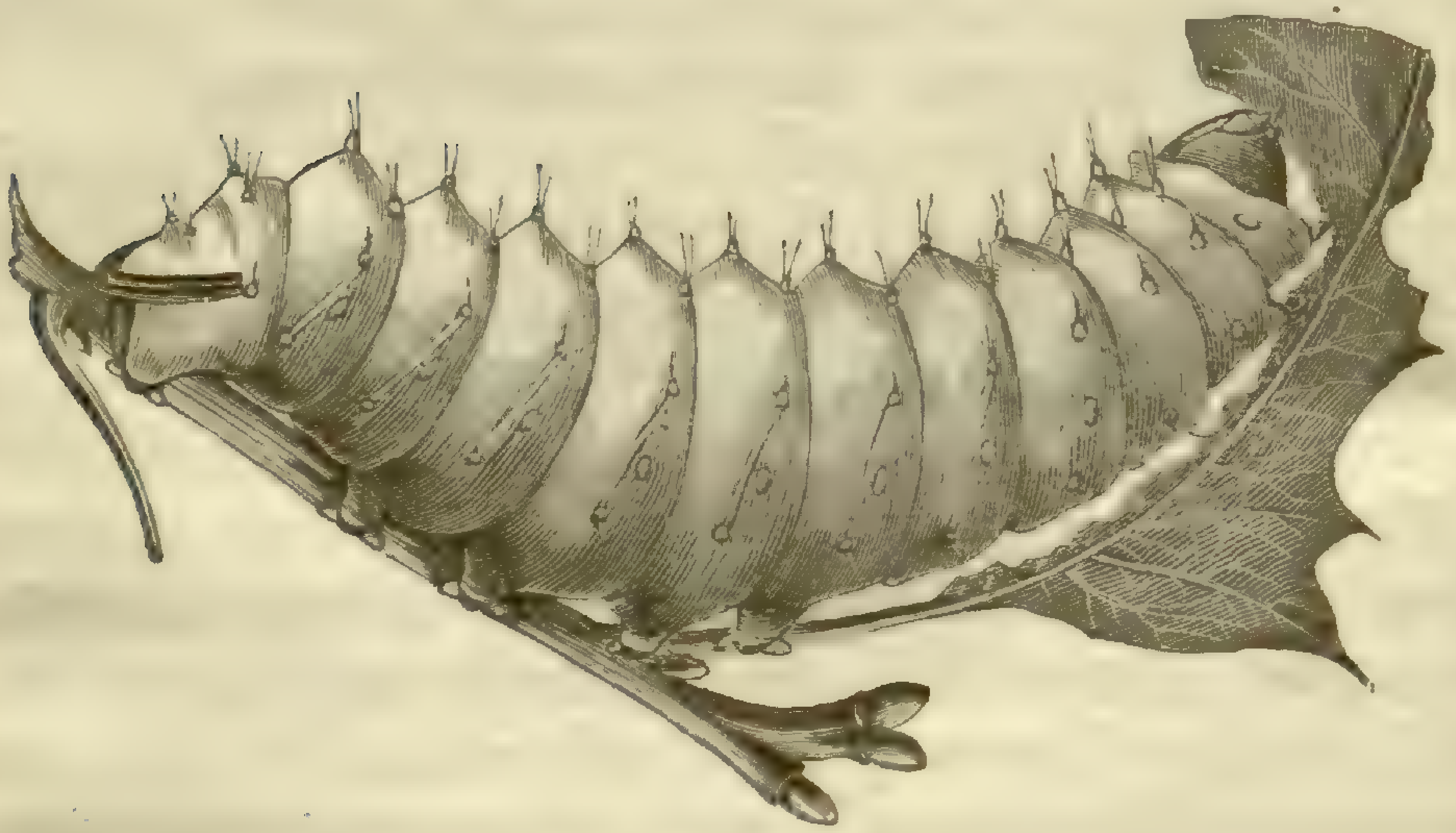
This carnivore, then, is an interesting link between those of the mammalian series, and the carnivorous birds. In the first, all four limbs are equally developed, and similarly employed as weapons of offence; in the last, the functions of the anterior pair are altogether different from those of the hind limbs, which are alone armed for the capture of food. In the Dinosaur, the hind limbs appear to have served the same purpose as in the Raptorial bird, while the fore limbs are simply miniatures of the same, and chiefly of service in carrying food to the mouth.

It will readily occur to the palæontologist, that the ex-

istence of creatures of the form of Lælaps, Iguanodon, and Hadrosaurus, would amply account for the well known foot-tracks of the Triassic Red Sandstone of the Connecticut Valley. The arguments adduced to prove that these were made by birds are equally applicable to their indicating the presence of Dinosaurians; and as the latter have been found very much more nearly approximated in time —as *Scelidosaurus* in the Jurassic formation—the latter hypothesis is altogether the more probable of the two in the estimation of the writer.

THE AMERICAN SILK WORM.

BY L. TROUVELOT.



The insect fauna of North America contains several gigantic species of moths belonging to the Lepidopterous family Bombycidæ. This family has long been known to spin when in the larval, or caterpillar state, a cocoon which produces a large amount of silk, with a fibre of the most delicate texture, of great strength and of the most

beautiful lustre. Every one is familiar with the beautiful and delicate fabric made from the fibres spun by that crawling repulsive creature, the silk worm.

Our country alone has eight or ten species of silk worms. Two of these, Callosamia Promethea and C. angulifera, feed on the lilac and wild cherry. They spin a small elongate cocoon of so very dense texture and so strongly gummed, that I have failed in all my attempts to reel the silk from the cocoon. These cocoons resemble very much those of Samia Cynthia, or the Ailanthus Silk Worm, recently introduced into Europe from China, but the cocoon is of a looser texture. Platysamia Euryale, P. Columbia and P. Cecropia feed upon many different species of plants; they make a large cocoon, within which is another cocoon, or inner layer, of an oval form; but as the larva in spinning the cocoon, leaves one end open for the exit of the moth, this prevents the reeling of a continuous thread. The silk, though quite strong, has not much brilliancy, and the worm is too delicate to be raised in large numbers.

The caterpillar of Tropæa Luna, the magnificent green moth with the long tail-like expansion of the hind wings, feeds upon the oak, sycamore and other trees, and spins an oval cocoon, which however is so frail and thin, and the fibre so weak, that it is impossible to reel it.

Practically, however, the larva of Telea Polyphemus is the only species that deserves attention. The cocoons of Platysamia Cecropia may be rendered of some commercial value, as the silk can be carded, but the chief objection as stated above, is the difficulty of raising the larva. The Polyphemus worm spins a strong, dense, oval cocoon, which is closed at each end, while the silk has a very strong and glossy fibre.

For over six years I have been engaged in raising the Polyphemus worm, and here present the following imperfect sketch of the progress made from year to year in propagating and domesticating these insects from the wild stock.

In 1860, after having tested the qualities of the cocoons of the different species of American silk worms, I endeavored to accumulate a large number of the cocoons of the Polyphemus moth, for the future propagation of this species. At first the undertaking seemed very simple; but who will ever know the difficulties, the hardships and discouragements which I encountered. This worm having never been cultivated, of course its habits were entirely unknown, though all success in my undertaking depended very much upon that knowledge. However I was not discouraged by the difficulties of the task. The first year I found only two caterpillars. The chance of their being each a male and female was very small, and it was another question whether the two sexes would come out of the cocoon at about the same time for the fecundation of the eggs. So success was very doubtful. Spring came, and with it one of the perfect insects; it was a male, one, two, three days elapsed, my poor male was half dead, the wings half broken, the other cocoon was not giving any signs of an early appearance; imagine my anxiety; it was a year lost. The male died on the sixth day. The other moth came out more than a fortnight after; it was a male also. During the summer of 1861, I found a dozen worms, knowing then a little about their habits. In the spring of 1862, I was fortunate enough to have a pair of these insects that came out of the cocoon at the proper time, and I obtained from their union three hundred fecundated eggs. The pair which gave me these eggs

were the originators of the large number which I have cultivated since. Of these three hundred worms, I lost a great many, not knowing their wants, but I succeeded in obtaining twenty cocoons in the autumn. It was only in 1865 that I became expert in cultivating them, and in that year not less than a million could be seen feeding in the open air upon bushes covered with a net; five acres of woodland were swarming with caterpillar life.

Natural History of Telea Polyphemus. Early in summer, the chrysalis of Polyphemus which has been for eight or nine months imprisoned in its cocoon, begins to awaken from its long torpor, and signs of life are manifested by the rapid motion of its abdomen. In the latitude of Boston, the earliest date at which I have seen a perfect insect is the twentieth of May. From this time until the middle of July, the moths continue to come out of the cocoons. The cocoon being perfectly closed, and a hard gummy, resinous substance uniting its silken fibres firmly together, it is quite hard for the insect to open it, as it has no teeth, nor instrument of any kind to cut through it, and the hooked feet are far too feeble to tear such a dense structure.

But the moth must have some means of exit from the cocoon. In fact they are provided with two glands opening into the mouth, which secrete during the last few days of the pupa state, a fluid which is a dissolvent for the gum so firmly uniting the fibres of the cocoon. This liquid is composed in great part of bombycic acid. When the insect has accomplished the work of transformation which is going on under the pupa skin, it manifests a great activity, and soon the chrysalis-covering bursts open longitudinally upon the thorax; the head and legs are soon disengaged, and the acid fluid flows from its mouth, wetting

the inside of the cocoon. The process of exclusion from the cocoon lasts for as much as half an hour. The insect seems to be instinctively aware that some time is required to dissolve the gum, as it does not make any attempt to open the fibres, and seems to wait with patience this event. When the liquid has fully penetrated the cocoon, the pupa contracts its body, and pressing the hinder end, which is furnished with little hooks, against the inside of the cocoon, forcibly extends its body; at the same time the head pushes hard upon the fibres and a little swelling is observed on the outside. These contractions and extensions of the body are repeated many times, and more fluid is added to soften the gum, until under these efforts the cocoon swells, and finally the fibres separate, and out comes the head of the moth. In an instant the legs are thrust out, and then the whole body appears; not a fibre has been broken, they have only been separated.

To observe these phenomena, I had cut open with a razor, a small portion of a cocoon in which was a living chrysalis nearly ready to transform. The opening made was covered with a piece of mica, of the same shape as the aperture, and fixed to the cocoon with mastic so as to make it solid and air-tight; through the transparent mica, I could see the movements of the chrysalis perfectly well.

When the insect is out of the cocoon, it immediately seeks for a suitable place to attach its claws, so that the wings may hang down, and by their own weight aid the action of the fluids in developing and unfolding the very short and small pad-like wings. Every part of the insect on leaving the cocoon, is perfect and with the form and size of maturity, except the pad-like wings and swollen and elongated abdomen, which still gives the insect a

worm-like appearance; the abdomen contains the fluids which flow to the wings.

When the still immature moth has found a suitable place, it remains quiet for a few minutes, and then the wings are seen to grow very rapidly by the afflux of the fluids from the abdomen. In about twenty minutes the wings attain their full size, but they are still like a piece of wet cloth, without consistency and firmness, and as yet entirely unfit for flight, but after one or two hours they become sufficiently stiff, assuming the beautiful form characteristic of the species. If, while the wings are growing, they are prevented from spreading by some agency, they will be deformed forever. Sometimes when the wings are developing, the afflux of liquid is so great, that some parts of the wing swell up considerably, and if one of these swellings be opened with a pin and the sac emptied a singular phenomenon will result; the wing which has lost so much of its fluids will be smaller than the others, and sometimes it will retain the normal form of the wing, only being smaller, while the wound can be detected only on very close observation. I have in my cabinet a perfect specimen of such an insect; naturalists would regard it as a monstrosity.

The moth remains quiet all day, and sometimes all night and the following day, if the night be cold; but if it be warm and pleasant, at dusk or about eight o'clock, a trembling of the wings is observed for a few minutes and then it takes its flight, making three or four circles in the air. The male flies only a few minutes, and then rests for two or three hours in the same place, not making any motion. It is worthy of notice that the place of rest is always the extremity of an oak leaf. Why he remains there so long I could not ascertain. The female continues to fly

about the bushes, and though a virgin, she lays eggs which are, however, of no use for the propagation of the species; she continues so doing for two or three hours, and then rests all night attached to some plant, probably waiting for her mate, who during this time has either remained motionless, or has been feeding on the sweet exudation of the oak leaf. Soon after the female moth has laid these useless eggs, the males become very active, and fly in search of their partners, whom they soon discover, especially if there be a slight breeze and the air loaded with vapors.

The moth lays her eggs on the under side of the leaves, sometimes on a twig; generally but a single egg is deposited at one place, rarely are two or three found together. I have observed that eggs are sometimes laid upon plants which the young larvæ refuse to eat, and in several instances where there was no other plant within a long distance, and consequently the young worms died; thus it seems that instinct, like reason, sometimes commits blunders, and is not so infallible a guide as has been supposed.

The incubation of the eggs lasts ten or twelve days, according to the temperature. The young worm eats its way through the shell of the egg; sometimes the young larva comes out of the egg tail foremost, as the hole in the shell is large enough to allow of the exit of the tail, but is not large enough for the head to pass through, so the worm is condemned to die in the egg. As soon as it is fairly hatched out, the larva continues for sometime eating the egg-shell, and then crawls upon a leaf, going to the end of it, where it rests for two or three hours, after which it begins to eat. The hatching-out takes place early in the morning, from five till ten o'clock; rarely after this time.

The Polyphemus worm, like all other silk worms, changes its skin five times during its larval life. The moulting takes place at regular periods, which come around about every ten days for the first four moultings, while about twenty days elapse between the fourth and fifth moulting. The worm ceases to eat for a day before moulting, and spins some silk on the vein of the under surface of a leaf; it then secures the hooks of its hind legs in the texture it has thus spun, and there remains motionless; soon after, through the transparency of the skin of the neck, can be seen a second head larger than the first, belonging to the larva within. The moulting generally takes place after four o'clock in the afternoon; a little before this time the worm holds its body erect, grasping the leaf with the two pairs of hind legs only; the skin is wrinkled and detached from the body by a fluid which circulates between it and the worm; two longitudinal white bands are seen on each side, produced by a portion of the lining of the spiracles, which at this moment have been partly detached; meanwhile the contractions of the worm are very energetic, and by it the skin is pulled off and pushed towards the posterior part; the skin thus becomes so extended that it soon tears, first under the neck, and then from the head. When this is accomplished the most difficult operation is over, and now the process of moulting goes on very rapidly. By repeated contractions the skin is folded towards the tail, like a glove when taken off, and the lining of the spiracles comes out in long white filaments. When about one-half of the body appears, the shell still remains like a cap, enclosing the jaws, then the worm as if reminded of this loose skull-cap, removes it by rubbing it on a leaf; this done, the worm finally crawls out of its skin, which is attached to the fastening made for the purpose. Once

out of its old skin, the worm makes a careful review of the operation, with its head feeling the aperture of every spiracle, as well as the tail, probably for the purpose of removing any broken fragment of skin which might have remained in these delicate organs. Not only is the outer skin cast off, but also the lining of the air tubes and intestines, together with all the chewing organs and other appendages of the head. After the moulting, the size of the larva is considerably increased, the head is large compared with the body, but eight or ten days later it will look small, as the body will have increased very much in size. This is a certain indication that the worm is about to moult. Every ten days the same operation is repeated; from the fourth moulting to the time of beginning the cocoon, the period is about sixteen days.

The worms seem entirely unable to discern objects with their simple eyes, but they can distinguish light from darkness, as a very simple experiment will show. If a worm be put in a box with two holes in it, one of them turned to the light, the other to the dark, the caterpillar will very soon come out through the hole turned to the light.—*To be continued.*

WINTER NOTES OF AN ORNITHOLOGIST.

BY J. A. ALLEN.

The winter birds of the northern and eastern States are few in number. In Massachusetts, away from the sea shore, there are ordinarily but fifty-five to sixty species, which consist mainly of permanent residents and winter visitors from more northern districts. The resident

kinds are either rapacious birds, or such hardy species as Titmice, Jays, Woodpeckers, Nuthatches, Finches and Grouse, whose means of subsistence is about equally sure at all seasons. A few are, more properly, migrant summer species, of which only hardy adventurous individuals linger with us in winter, the majority seeking a milder home farther south: among such are the Meadow Lark, Kingfisher, Cedar Bird and Robin. The winter visitors are all from the north; many of these are irregular in their visits, coming to us only when driven southward by the severity of the weather, or more probably by scarcity of food. Of this whole number the limits of our paper will allow us to notice but a few, and even of the more interesting to give but very brief accounts.

The rapacious or raptorial birds, the Hawks and Owls, though comparatively numerous in species, are not so in individuals. Shy and mistrustful, seeking the retirement of the wilderness or the forest, and the nocturnal kinds active only by night, they form but an inconspicuous feature in our local ornithology. Constantly persecuted by man, they have decreased greatly in numbers since the first settlement of our country, and every year they seem more and more to avoid the cultivated districts, seeking a more congenial home in the less inhabited parts of the continent.

Of the true or typical Falcons, esteemed the "noble" birds of prey in the old days of falconry, we have in winter, as at other seasons, now and then a Duck Hawk or Peregrine Falcon (*Falco anatum* Bon.), a Pigeon Hawk (*Hypotriorchis columbarius* Gray), and a Sparrow Hawk (*Tinnunculus sparverius* Vieill.), but so rare are they that a careful observer will ordinarily see but one or two of each in a winter, or perhaps oftener none at all. The

first of these, the dreaded Duck Hawk, is frequent along the sea border and large open rivers where abound the aquatic birds that form his chief prey. The celebrated White Hawk or Jer-Falcon (*Falco candicans* Gm.) is larger and more powerful even than the Peregrine, but it comes to us so rarely from its remote arctic home, as to be justly considered but an accidental wanderer.

Of the hawks, properly so called: namely, the short winged and "ignoble" birds of prey, the majority are migratory in the more northern sections of the Union, going south in winter. One, however, the Gos-Hawk (*Astur atricapillus* Bon.) is a winter visitor, and subsisting upon rabbits, partridges, jays, and such other birds and poultry as fall in his way, is a bird of considerable celebrity for his strength and boldness. Formerly his European ally of the same name, and with which the earlier ornithologists supposed ours to be identical, was held in great esteem in hawking, and according to Pennant, was considered of unequalled value among the short winged hawks for the purposes of falconry. It is, moreover, when mature, of beautiful plumage, the white under surface being elegantly pencilled transversely with waved ashy-brown lines, and with broader longitudinal stripes of a dark ferruginous hue. The young are more plainly colored, and differ for several years so widely from their parents, as to be hardly recognizable as belonging to the same species. I once found a wing of this bird, which had been dropped in the woods by some bird of prey; the flesh had been torn from it, leaving only the bones of the upper and fore arm, and the primary quills, showing that even such tyrants of the air are not exempt from enemies more powerful even than they. Possibly it was the Duck Hawk that in this case was the destroyer, since its representa-

tive in Europe, the Peregrine, is known to have a particular relish for the flesh of other hawks, and to hunt the poor Kestril as its most dainty game.

The well known "Red-tail," (*Buteo borealis* Gm.) from his retreat in the forest, sometimes makes sudden forays on the poultry. Several kinds of large and sluggish hawks silently await in the open meadows the appearance of their minute but favorite game, the field mice, and the Marsh Harrier (*Circus Hudsonius* Vieill.) anon skims rapidly over the snowy fields in eager quest of food. But the most beautiful, when in mature plumage, as well as the largest of our winter birds of prey, is the historical White-headed, or Bald Eagle (*Haliætus leucocephalus* Savig.), most inappropriately chosen for our national emblem. The Golden Eagle (*Aquila Canadensis* Cass.), a far nobler bird, is perhaps almost too uncertain a visitor to warrant enumeration in our list.

The Strigidæ, or Owls, the "mysterious birds of night" are even less common than the preceding group, though in winter the number of species is increased by migrants from the north. The resident kinds of most frequent occurrence are the Mottled Owl, (*Scops asio* Bon.) perhaps better known as the "Screech Owl", the Great Horned or Cat Owl (*Bubo Virginianus* Bon.), the Barred Owl (*Syrnium nebulosum* Gray), the Short-eared Owl (*Brachyotus Cassinii* Brew.), and the Long-eared Owl (*Otus Wilsonianus* Less.) Of the migratory species the most common and best known is the Snowy Owl (*Nyctea nivea* Gray) which visiting us, at times, in considerable numbers, at once attracts attention from its large size and white plumage. Very rarely the Great Grey or Cinereous Owl (*Syrnium cinereum* Aud.), one of the largest and most handsome of the American Owls, pays us a visit

from his home in the Canadas and sub-arctic regions. In northern New England the semi-diurnal Hawk Owl (*Syrnia ulula* Bon.) is comparatively common, and lurking near the hunter profits by the pieces of game which he throws away, or now and then captures wounded birds.

Excepting the cruel, selfish and solitary raptorial species, our winter birds mostly associate in groups, not of individuals of a single kind merely, but of species, drawn together chiefly perhaps from similarity of food, and probably also from real love of each other's society. The winter representatives of these birds are of larger size, and of brighter colors than those seen in summer.

In the savage Butcher Bird or Northern Shrike (*Collyrio borealis* Baird), which seems but a hawk in miniature, we have, nevertheless, an exception to the gregarious tendency generally observed in winter among our smaller birds. He is one of our regular, but not very numerous visitors during the colder parts of the year, though less common than in the fall and spring; when those that winter farther south pass us in their migrations. It is, however, bolder, recklessly pouncing on birds in cages exposed near open windows. The song of a Canary will often retain him in the vicinity for a long time, waiting, restless and impatient from hunger, for an opportunity to make it his victim. In the woods he is continually quarrelling with the Jays, which both fear and hate him, and I have seen him in hot pursuit of a Chickadee, which was trembling with fright.

In winter all our birds seem to possess an unusual interest, perhaps no less from their scarcity than from the cheeriness their presence seems to lend. None, however, are dearer to me than the little woodland group of Titmice, the Nuthatches, the Creepers, the diminutive King-

lets, and the spotted Woodpeckers we so frequently meet in our forest walks.

Although the smallest of all our birds, except the Humming Bird, the Gold-crested Kinglet (*Regulus satrapa* Licht.) is one of the most hardy of our winter visitors, and is the more interesting from his exceeding diminutiveness. With a body hardly larger than a hickory nut, it is so thickly clothed with downy plumage that on a cold morning, when every delicate feather is fully expanded he looks like a ball of animated down, and thus clad, he is able to defy old Boreas.

Our winter field birds, like the field birds of summer, are chiefly members of the numerous Sparrow and Finch family, or Fringillidæ. Among them the beautiful Snow Bunting (*Plectrophanes nivalis* Meyer) is one of the largest, and when whirling from field to field in compact flocks, their white wings glistening in the sunlight, form one of the most attractive sights of winter; and most commonly appearing about the time of heavy falls of snow, and disappearing during continued fine weather, there is in the popular mind a degree of mystery attached to their history, being the "Bad weather Birds" of the superstitious. Cold half-arctic countries being their chosen home, they only favor us with their presence during those short intervals when their food in the northern fields is too deeply buried; and being strong of wing and exceedingly rapid in flight, they can in a few hours leave the plain for the mountain, or migrate hundreds of miles to the northward. The most common and frequently seen however, is the Yellow Bird (*Chrysomitris tristis* Bon.), but so changed in appearance in his plain winter suit of drab, that he is scarcely recognised as the beautiful Goldfinch we so much admired in summer. Feeding on the

abundant supply of nutricious seeds furnished by the weeds that rise above the snow, as well as on the seeds of the hemlock, the spruce, the larch, the alder and birch of the swamps and thickets, he never lacks for food, even in the severest weather; roving in flocks, social and joyful, he seems the very ideal of contentment. One of his more common associates is the Pine Finch, or Northern Siskin, (*C. pinus* Bon.); though rather more partial to the forests than he, they greatly resemble each other in their notes and general habits; but the latter, from its more pointed wings and slender form, is swiftest in flight, and possesses milder and more wiry notes, often heard while its author is far beyond our sight.

Some of the members of this large family, such as the two species of Crossbills, depend so much for food on the coniferous forests as to be seldom seen far away from their borders. The Common or Red Crossbill (*Curvirostra Americana* Wilson), though partially resident, is of desultory habits, and is never commonly seen, except when the pine woods, their usual home, are well laden with cones. The White-winged (*C. leucoptera* Wilson), its smaller but more beautiful congener, and an inhabitant of the northern forests of the Old World as well as of America, we only see at irregular intervals, commonly years apart. The winter of 1859-60 is memorable with bird collectors for their great abundance in our spruce and larch swamps, as well as for the occurrence of a very unusual number of other northern strangers. The Crossbills, by the great strength of their maxillary muscles, and their strong oppositely curved mandibles, are able to pry open the tightly appressed scales of the fir cones, and to extract at pleasure the oily seeds, which other birds equally fond of have to wait for the elements

to release. The Pine Grosbeak, or the Bulfinch of the North (*Pinicola Canadensis* Cab.), is another species more or less dependent on the forests, the Virginia Juniper affording him favorite food. His home, too, is the mountains and uninhabited northern timber lands. They visit us but occasionally, and then in such small parties, locally distributed, as to escape general observation.

Among our more familiar resident birds, there are but few species that seem as numerous in winter as at other seasons; of these the Blue Jay (*Cyanura cristata* Swains.). is a prominent example. Though unusually social in his disposition, he is yet hardly gregarious. The noisy screams of small scattered parties reach us from the swamps and thickets almost daily, and in the severer weather individuals make frequent excursions to the orchard and farmers' cribs of corn, the few grains they pilfer being amply paid for in the destruction of thousands of the eggs of the noxious tent-caterpillar. The poor Crow (*Corvus Americanus* Aud.), despised or persecuted by nearly all, is a bird of unusual interest to every lover of nature, and is a true friend to the farmer, though he finds in the latter a most inveterate enemy. The few Crows that remain with us during the long cold winter, seem able to support but a miserable existence; but no sooner does returning spring and the bare earth afford them a supply of grubs and other noxious insect larvæ, than they fare liberally, and their labors thus contribute vastly to the welfare of the farmer. Capable of withstanding the deforesting of the country, which has exterminated so many of our larger birds, he needs but little encouragement to become one of our most familiar and useful birds.

Passing by numerous species of our winter birds, including the rasorial kinds, or the Grouse and their allies,

and others of equal interest with those already mentioned, we have but space to notice very briefly some of our winter water-fowl. Those found at this season inland or remote from the sea, are so exceedingly few as scarcely to attract attention. They are confined exclusively to the tribes of Ducks and Grebes. The Whistle-wing or Golden-eyed Duck (*Bucephala Americana* Baird), the Goosander or Sheldrake (*Mergus Americanus* Cass.) and the Hooded Merganser (*Lophodytes cucullatus* Reich.), are occasionally seen on the rivers about open water, being much more common at the beginning of the season or towards spring, than in mid-winter. Along our coast, however, are found numerous representatives, many of which are visitors from more northern regions, and nearly all of which are of rare or of unknown occurrence very far inland. These by their numbers serve most agreeably to enliven our bleak coast. Such are the Gannets and Shearwaters, Jager Gulls and Terns, with the Eider Duck, Puffin, Auks and Guillemots.

The number of common species of winter birds is less than *one-tenth* the number of the common species in other seasons; while the difference in the total number of individuals is even much greater, a scarcity of birds being eminently, in our latitude, one of the characteristics of the season of winter.

In reviewing carefully a complete list of our Winter Birds, we are forcibly struck with the small proportion of species that can be considered as regularly common. Thus, out of nearly sixty species of inland birds that are known to inhabit southern New England in winter, we find but fourteen that we can hope to meet with at all frequently; the remaining seventy-six per cent. falling into the class of rare, though regularly occurring, migrants

and residents, or into the list of irregular and occasional visitors. The proportion of rare species to common ones, of irregular visitors to the regular, is perhaps well exhibited by the subjoined tabular *résumé:*

Species	common	14
"	rare	45
"	resident	26
"	migrant	33
"	irregular in their visits (and occuring in winter only).	7
"	of summer that linger occasionally in winter . .	4
Total of Winter Birds		59

The following table further shows what families are represented, and the number of species of each, as well as the number resident and migrant, rare and common.

		Common.	Rare.	Resident.	Migrant.
1.	Falconidæ (*Hawks*) . . .	0	9	5	4
2.	Strigidæ (*Owls*)	0	9	6	3
3.	Picidæ (*Woodpeckers*) . .	2	1	2	1
4.	Alcedinidæ (*Kingfishers*) . .	0	1	0	1
5.	Turdidæ (*Thrushes, etc.,*) .	0	2	0	2
6.	Bombycilidæ (*Waxwings*) .	0	2	1	1
7.	Laniadæ (*Shrikes*) . . .	0	1	0	1
8.	Liotrichidæ (*Wrens, etc.*) .	0	1	0	1
9.	Certhiadæ (*Creepers*) . .	1	0	1	0
10.	Sittidæ (*Nuthatches*) . .	1	1	1	1
11.	Paridæ (*Titmice*) . . .	1	0	1	0
12.	Fringillidæ (*Finches, etc.*) .	2	8	1	9
13.	Icteridæ (*Troupials*) . .	0	1	0	1
14.	Corvidæ (*Crows and Jays*) .	2	0	2	0
15.	Tetraonidæ (*Grouse*) . .	1	0	1	0
16.	Perdicidæ (*Quails*) . . .	1	0	1	0
17.	Anatidæ (*Ducks*) . . .	2	5	3	4
18.	Colymbidæ (*Divers*) . .	1	4	1	4
		14	45	26	33

The whole number of families represented, as may be seen from the above exhibit, is eighteen; only five (Falconidæ, Strigidæ, Fringillidæ, Anatidæ, Colymbidæ) have each more than three species, and excepting those of one family (Fringillidæ), are all to be reckoned among the rarer kinds. The Fringillidæ, or Finch family, has the greatest number, and probably in individuals outnumbers all the others together; it has, however, but a single resi-

dent species (the Yellow Bird), and only two (the Yellow Bird and Tree Sparrow), that can be counted as regularly common in winter. The two families of raptorial birds have each five or six resident species, but of the total of nine species furnished by each, all, as already observed, are rather rare species.

REVIEWS.

On the Lysianassa Magellanica, and on the Crustacea of the Suborder Amphipoda and Subfamily Lysianassina found on the Coast of Sweden and Norway. *By Prof. William Lilljeborg.* pp. 38, with 5 plates. *Upsala*, 1865. 4to.

In this well illustrated paper, which is written in our own language, we are introduced to a very remarkable exception to the usual law of the distribution of animals. A species, one of the most gigantic of its group, being three inches in length, which was first discovered near Cape Horn, by D'Orbigny, reappears, upon the authority of Prof. Fries, near Spitzbergen, "on the bank by Beering Island." The specimens from the two localities were not actually compared, but a drawing and description of the *Lysianassa Magellanica*, from Spitzbergen, were found to agree perfectly with Milne Edwards' type-specimen collected by D'Orbigny. Sceptics may require the specimens to be placed side by side, before accepting the conclusions of even such eminent authorities as those named above. Other species of animals are said to be common to both poles. Three species of shells, "Saxicava arctica, Venus pullastra, and Pecten pusio," and a Crustacean, are said by the author to be "found both on our northern coasts, and at the Cape of Good Hope, though not in the intermediate tropical regions." The author enumerates several *genera* of interpolar shells, and also quotes as follows from Prof. Fries regarding the plants of these regions:

Hooker enumerates *Erigeron alpinus*, *Carex festiva*, *Phleum alpinum* and *Trisetum subspicatum*, but it is probable that on closer examination these will be found to be nearly related, but different species. A remarkable example of a species common to both the Arctic and Antartic regions, and not met with elsewhere, is afforded by the beautiful and easily distinguished species of moss, *Usnea melaxantha*, which is met with in Greenland and Spitzbergen, as well as in New Zealand and the most southerly portions in America. The only difference between the northern and southern forms is, that the latter seems

more thriving and fructifies richly, whereas the former is a more delicate plant, and has never yet been met with in a fructificating state. It is also curious that a so remarkably distinct form as the *Nephroma arcticum*, which is so generally met with in the northern alpine and subalpine regions, should nowhere else be represented by any analogous or similar form, excepting at Magellan Straits, where the very similar and nearly related *Nephroma antarcticum* is met with. Among the phanerogamous [flowering] plants, the genus Empetrum presents the same phenomenon, being in the north, principally represented by the *Empetrum nigrum*, whereas in Antartic America the *Empetrum rubrum* is the prevailing species, unless (as I have lately seen asserted) this latter be also found in Northern America.

No species of vertebrate animal is known with certainty to be common to both poles.

CONTRIBUTIONS TO THE KNOWLEDGE OF CRUSTACEA, FOUND LIVING IN SPECIES OF THE GENUS ASCIDIA. *By T. Thorell.* From the Transactions of the Royal Academy of Science of *Stockholm.* Bd. iii., pp. 84, 14 plates. 4to.

In this valuable paper we have a very full account of some curious little crustaceans, allies of our common water-fleas found swimming in our fresh water pools. These strange forms are parasitic in the outer thick envelope (test) of the ascidians, or "shelless clams"; much as *Pinnotheres ostreum*, the little oyster crab, lives as a guest in the shell of the oyster. Observers should be on the look out for them in the ascidians of this country.

ON THE POLYPES AND ECHINODERMS OF NEW ENGLAND, WITH DESCRIPTIONS OF NEW SPECIES. *By A. E. Verrill.* From the Proceedings of the Boston Society of Natural History, April 18, 1866. pp. 25. 8vo.

Professor Verrill here gives us a very useful list of all the sea Anemonies, Star-fish and Beche-le-mers, or Sea-cucumbers, as they are often called, which are found on our north eastern coast. To those who may be dredging, or engaged in the less exciting search for these interesting forms in the tidal pools, and under the sea weeds along the shore, this pamphlet will be invaluable.

THE MYRIAPODA OF NORTH AMERICA. *By Prof. Horatio C. Wood, jr.* From the Transactions of the American Philosophical Society. *Philadelphia,* 1865. pp. 92, illustrated with 3 plates and over 60 cuts. 4to.

To young collectors and entomologists generally, the Thousand-legs and Centipedes one occasionally meets with in his rambles, are stumbling blocks. In this monograph, containing so complete an account of their structure and forms, the author has filled a great gap in American Natural History. The plates are in the main very well drawn: but there has been an oversight in representing all the legs pointing towards the tail, which is not the natural position. Those on the anterior half of the body should have been directed towards the head.

NATURAL HISTORY OF ANIMALS. *By Prof. Sanborn Tenney and Mrs. Abby A. Tenney.* New York, 1866. Scribner & Co. 12mo.

This little work, as the title indicates, presents in a general way the Natural History of Animals. The illustrations are mainly the same as those contained in a previous work by Prof. Tenney on Natural History. The figures are mostly drawn from American sources, and the book will be found quite useful to those who wish to obtain a knowledge of our native animals. As the work is intended for beginners, the style is plain and free from technicalities. Yet we regret the absence of the technical names, for we believe that on all occasions, the scientific name of an animal should be coupled with its common one, so that gradually the popular mind may become accustomed to the use of that which is so essential to a proper understanding of the study, and more particularly, a clear appreciation of the value of classification.

ON THE YOUNG STAGES OF A FEW ANNELIDS. *By Alexander Agassiz.* From the Annals of the Lyceum of Natural History, New York. Vol. viii., p. 303. June, 1866, 6 plates, pp. 40. 8vo.

In this interesting article we find accounts of the early lives of some of our common marine worms. Though necessarily fragmentary, from the difficulty of obtaining these creatures in all their stages of growth, yet such facts as we here learn about the early stages of the Nareda-like worm, are of the highest interest to the philosophic naturalist.

This worm is a long, narrow, smooth-bodied Nemertean, with two eye-specks on the head. The absence of the locomotive bristles and tentacles, found in the higher worms, such as Nereis, show its near relationship to the intestinal worms. But the metamorphosis is remarkable. The young is provided with two tentacles, which in the course of development drop off, thus affording us an instance of a retrograde course of development in the class of worms, like the Barnacle among Crustacea, the young of which have feet and antennæ, as in the little water fleas (Entomostraca), while in advanced life these limbs mostly drop off, and the animal would easily be mistaken for a shell fish.

We quote some directions for observing and collecting these young worms, so interesting as objects for the microscope:

Johannes Muller was the first who successfully employed surface dredging with a fine gauze net; he has been followed with eminent success by many of his pupils, and now scooping the surface of the sea in search of diminutive animals, scarcely to be recognised with the naked eye, is one of the most profitable sources of supply for recent investigators at the sea-shore. Baur has introduced fishing with the gauze net by sinking it to any desired depth, and this promises to be a fruitful mode of finding what cannot be reached with the hand net. Meyer and Mobius, in their investigations of the Fauna of the Bay of Kiel, have even attempted, with remarkable good fortune, to pump up from the vicinity of the bottom any animals there abounding.

Artificial fecundation can do much towards adding to our knowledge of the early stages

of marine animals, but any one who has lived at the sea-shore and endeavored to keep alive these tiny creatures, will soon find in this method insurmountable obstacles to pursuing his investigations beyond very narrow limits. The only way is to go to the fountain head at once, to make oneself familiar with the currents at all hours of the tide and under all possible influences of wind: to notice the place where opposite currents meet, and throw into long bands the wealth of animal life they have swept along; to become so perfectly familiar with what you may expect to find under certain conditions, that no time shall be lost in looking for the most favorable spot which otherwise you would only stumble upon accidentally. The habitat of the adult animals should be carefully observed, so that by surface dredging with the fine gauze hand-net in the vicinity of their abodes, and by a close attention to the direction which the currents take from these places, at the time of breeding, we can often obtain specimens at all ages and of all sizes, till they have ceased to be nomadic or have assumed the habits they retain in their adult condition.

NATURAL HISTORY MISCELLANY.

BOTANY.

THEORY OF THE ORIGIN OF THE ANTHER OF FLOWERS.—Dr. Müller read a memorandum of the monstrosities which he had met with in the flower and fruit of the *Jatropha pohliana*, and deduced therefrom some conclusions on the theory of the anther. He thinks that this is formed neither by the combination of two ordinary leaves, nor by a leaf whose edges are incurvated towards the median rib, so as to form the two chambers of the pollen. He believes that the anther represents only a single leaf, and that the pollen is developed in the incrassated tissue of the parenchyma of this leaf.—*Report of the Transactions of the Society of Physics and Natural History of Geneva*, 1863-5. *Smithsonian Report*, 1865.

PHYSIOLOGICAL EFFECTS OF THE CALABAR BEAN.—Dr. Dor read a memoir on the physiological effects of the bean of Calabar, *Physostigma venenosa*. Studied specially in its effects on the eye, this substance produces contraction of the pupil, and occasions a sort of cramp of the accomodator muscle. In this double relation it acts as an antagonist of the atropina.—*Ibid.*

SKELETON LEAVES.—The following method has been communicated to the Botanical Society of Edinburgh:—"A solution of caustic soda is made by dissolving 3 oz. of washing soda in 2 pints of boiling water, and adding 1½ oz. of quick lime, previously slacked; boil for ten minutes, decant the clear solution and bring it to the boil. During ebullition add the leaves; boil briskly for some time—say an hour, occasionally adding hot water to supply the place of that lost by evaporation. Take out a leaf and put into a vessel of water, rub it between the fingers under the water. If the epidermis and parenchyma sepa-

rate easily, the rest of the leaves may be removed from the solution, and treated in the same way; but if not, then the boiling must be continued for some time longer. To bleach the skeletons, mix about a drachm of chloride of lime with a pint of water, adding sufficient acetic acid to liberate the chlorine. Steep the leaves in this till they are whitened (about ten minutes), taking care not to let them stay in too long, otherwise they are apt to become brittle. Put them into clean water, and float them out on pieces of paper. Lastly, remove them from the paper before they are quite dry, and place them in a book or botanical press."—*Dr. G. Dickson, Hardwicke's Science Gossip, Jan.* 1. 1867.

ZOÖLOGY.

The Edible Crab in Salem.—A large specimen of the common Edible Crab of the Southern markets, *Lupa dicantha*, was caught in the Millpond during the past winter. With the exception of a young specimen found on Phillips' Beach, it has not before been known to occur so far north as Massachusetts Bay. The Millpond is an inlet of Salem harbor, and the water is quite salt.—C. Cooke.

Mimetic Forms among the Butterflies. — Mr. A. R. Wallace states before the British Association, that "the *Heliconidæ*, a group of butterflies with a powerful odour, such as to cause birds to avoid eating them, were simulated by the females of another group, which had no smell, and might otherwise fall ready victims to birds. By their great resemblance to the obnoxious butterflies, the scentless females were enabled to escape pursuit, and deposit their eggs."—*The Reader, London, Oct.* 6, 1866.

Fertile Workers among the Honey Bees.—Mr. Tegetmeier, at the meeting of the Entomological Society of London, June 4, 1864, exhibited some drones hatched from eggs laid by fertile workers:

They were produced by placing in March, a comb containing eggs and larvæ *in workers' cells only*, in a hive which had been sometime without a queen, and which consequently contained no brood whatever. There was no apparent attempt made by the bees to form a royal cell and to rear a new queen from the workers' eggs, but after the latter were hatched the bees produced from them laid eggs. These were deposited in the drone cells only, sometimes as many as six being placed in one cell, of which only one was hatched, a drone in all cases being produced. It was noticed that these fertile workers were hatched and laid eggs before any drones had been observed in the adjacent hives. Huber supposed that such workers were produced by partaking of some of the food designed for the production of a queen, which had been deposited in the cells adjacent to the royal-one. This supposition was disproved, as there was no royal cell in the single brood comb which the hive contained.

He shows that a too close interbreeding in bees is prevented by drones from other hives entering into the hive—while stranger work-

ers are killed, stranger drones are readily received; thus the deterioration of the race is prevented.

A Black Variety of the Common Red Squirrel, *Sciurus Hudsonicus* Pallas. I have lately obtained a black specimen of the common Red Squirrel. It was killed at Letang, New Brunswick, where neither the Grey, nor the common Black Squirrel are known to occur.—G. A. Boardman.

GEOLOGY.

Discovery of a Human Jaw in a Belgian Bone Cave.—Dr. Dupont has discovered in the Bone Caves of Farfooz, near Dinant, in Belgium, a strange human jaw. It is the opinion of Sir. W. V. Guise, and Rev. W. S. Symonds, who have examined this locality,

"That the geological period of the entombment of the human jaw, with the remains of the extinct animals with which it was associated, may be assigned to the epoch known to geologists as the *low level drift period* of Prestwich, a period recent in a geological sense, but enormously remote when measured by *time*, for the cold of the glacial epoch was not altogether passed, and the extinct mammalia were still in existence. It was the period of the deposition of the old river drifts of Menchecourt, near Abbeville, which contain their human flint implements, interbedded with the bones of the Mammoth and Rhinoceros; the period of the deposition of the ancient river beds near Salisbury, and other parts of England, which teach the same history; and also, they believe of the English bone caverns."—*The Reader, London, Sept.* 1, 1866.

A Lizard-like Serpent from the Chalk formation of England.—Fossils indicating a creature of this character have been discovered by Mr. H. E. Seeley.—*The Reader, London, Oct.* 6, 1866.

Discovery of Genuine Chalk in Colorado and Dacota.—"Chalk has at last been found in this country—genuine chalk, with flints and an abundance of fossils. Smoky Hill, Colorado, is an outlying mass of chalk, probably the only remainder of a vast mass which denudation has removed."—*T. A. Conrad, Smithsonian Report*, 1865.

Dr. F. V. Hayden has also discovered in Yankton, Dacota Territory, large deposits of a "nearly white, soft chalk," which "will be found to represent the White Chalk Beds of Europe, and be employed for similar economical purposes."—*Amer. Journal Science and Arts, Jan.* 1867.

CORRESPONDENCE.

On the Plumage of the Black Guillemot.—How does it happen that we find the Black Guillemot (*Uria grylle* Lath.), in full black plumage all winter? All our works on Natural History tell us they change to white or grey in winter, but I often get specimens which are black in mid-winter. May it not be that only the young are light in winter? I can hardly think it possible some would remain black, and others change; I can see no difference between my dark winter and summer specimens.—G. A. Boardman, *Milltown, Me.*

NATURAL HISTORY CALENDAR.

Ornithological Calendar for March.—In this Calendar we have endeavored to indicate the average time of the arrival and departure of the migratory birds in the State of Massachusetts for this month; in years when the cold of winter ceases earlier or later than the average opening of spring, as well as in districts north or south of this State. When the dates are found to be respectively too early or too late, the difference increasing in the latter, cease with the increase of the difference in latitude. Thus, some birds wintering in the Southern States, reach Washington, D. C., in their northward migration three weeks earlier than they do Massachusetts; in Southern Pennsylvania two weeks, and Southern New York nearly one week earlier; while the same species commonly reach the middle of Maine some ten to twelve days later than they do Massachusetts.

1st to 10th.—Blue Birds, Song Sparrows, Robins, Purple Grakles, Red-winged Black Birds, Rusty Grakles and Cow Birds, begin to arrive.

10th to 20th.—The preceding become more common. Meadow Larks, Bridge Pewees or Phœbes, Snow Birds and Purple Finches, begin to arrive; the Hawks that in winter are represented by but few individuals, as the Marsh, Red-tailed, Red-shouldered, etc., increase in numbers by arrivals from the South. The Goshawks, Snowy Owls and other Northern visitors of the raptorial tribes mostly retire northwards.

20th to 31st.—All those previously arrived receive new accessions to their numbers, and become generally distributed. Grass Finches, Mourning or Carolina Turtle Doves, Passenger Pigeons (of late, uncertain visitors), and the Fox-colored Sparrows arrive; the Black Duck (*Anas obscura*), Canada and Brant Geese, Goosanders or Sheldrakes, Whistle-wings or Golden-eyes, Wood and Pintail Ducks, Red-breasted and Hooded Mergansers, Divers, and several species of Grebes begin to frequent the rivers and open ponds, as well as the coast. Some of the sea-fowl that are winter visitors, as the Eider Duck, Double-crested Cormorant, Skuas or Jager Gulls, Black-backed and Laughing Gulls, and Guillemots, return northwards; other kinds, as the Red-headed, Canvas-back, Ruddy, Surf Ducks, Scoters, King, Eiders, Kittiwake and Bonaparte's Gulls, Arctic Tern, and other species of the Duck and Gull tribes begin to arrive from the South; Snow Buntings and such rare land birds as the Pine Grosbeak, White-winged Crossbill, the Arctic Three-toed Woodpecker (*Picoides arcticus*) and Lesser Redpoll, leave for the north, as do also many of the Butcher Birds.

Such early breeding species as some of the Hawks and Owls pair during this month; some, as the White-headed Eagle, Duck Hawk

and Great Horned Owl, which begin their courtships as early as February, choose their eyries, and the former commences incubation. Blue Birds frequently pair before the end of the month, and taking possession of breeding boxes or holes in trees, guard them carefully against intruders.—J. A. A.

The Robins often lay the eggs for their first brood in March, in the vicinity of Salem.—Eds.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

American Academy of Arts and Sciences, *Boston. Jan.* 8, 1867. The following papers were read:

Thermogenesis, or Theory of Temperature, by Dr. J. D. Whelpey, of Boston.

The Object and Method of Mineralogy, by T. Sterry Hunt, of Montreal, Canada.

On the Inequalities produced in the Moon's Motion by the Secular Variation in the position of the Ecliptic, by G. W. Hill, of Cambridge.

Essex Institute, *Salem. Jan.* 7, 1867.—The following paper was presented:

A Catalogue of the Birds of North America contained in the Museum of the Essex Institute, with which is incorporated a List of the Birds of New England, with brief critical notes, by Elliott Coues, M. D., U. S. A.

Mr. C. Cooke made some remarks on the Sea Coco (*Lodoicea sechellarum*); and Mr. E. Bicknell exhibited sections, mounted for the microscope, of the poison fangs of the Rattlesnake.

Academy of Sciences, *Chicago. Annual Meeting, Jan.* 8, 1867.—Dr. William Stimpson was appointed Director of the Museum, to fill the vacancy caused by the death of Major R. Kennicott.

The President, Geo. C. Walker, Esq., delivered his annual address.

The Secretary then submitted his annual report.

The following resolutions were passed:

Whereas, The appropriation for the Illinois General Survey has been too small to allow of a sufficiently rapid examination:

Resolved, That this Academy desires to express its sense of the great importance of this work, and its hope that the appropriation will be increased to a degree that will carry on the State Survey with a greater rapidity than heretofore.

Resolved, That our Representatives in the General Assembly be respectfully requested to favor the increase of the appropriation.

Boston Society of Natural History. *January* 2, 1867.—Mr. Horace Mann exhibited a large panoramic photograph of the crater on the summit of Haleakala, the mountain of East Maui, Hawaiian Is-

lands. This crater is situated on the summit of Haleakala, its rim being at the average elevation of 10,000 feet above the sea. Its depth is about 2,000 feet, and the comparatively level plain which forms its floor, therefore, at an elevation of 8,000 feet. The whole circumference of the crater is thirty or thirty-five miles, it being one of the largest in the world.

Mr. Winwood Reade, of England, who was present as a visitor, read to the Society a paper upon the habits of the Gorilla, the result of his personal investigation in the Gaboon region.

Section of Entomology, Jan. 23.—Mr. Scudder remarked on a small collection of fossil insects obtained by Prof. William Denton, in the Tertiary, probably Miocene, beds of Green River, near the boundary line of Colorado and Utah Territories. The number of species amounts to about fifty, though they are so imperfectly preserved as to be difficult, if not impossible, to identify.

The most abundant forms are Diptera, and they comprise indeed two-thirds of the whole number, either in the larval or imago state; the others are mostly very minute Coleoptera, and there are besides several Homoptera, minute parasitic Hymenoptera, *Pteromali*, a *Myrmica*, a moth, and a larva, apparently allied to that of *Limacodes*.

The perfect Diptera are mostly small species of Mycetophilidæ and Tipulidæ. There are besides some which are apparently Muscidæ. Among the larvæ are those of Muscidæ, together with other larvæ belonging to species of which the adults are not represented on these stones. The Homoptera belong to genera allied to Issus, Gypona, Delphax and some of the Tettigonidæ. The collection does not agree, in the aggregation of species, with any of the insect beds of Europe, or with the insects of the amber fauna on the shores of the Baltic.

A paper was also read *On Monstrosities observed in the wings of Lepidopterous Insects, and on the method of producing them artificially*, by L. Trouvelot.

ILLINOIS NATURAL HISTORY SOCIETY. *Bloomington, Annual Meeting, December* 19, 1866. The following resolution was passed:

Resolved, That the corresponding secretary and the general commissioner be instructed to correspond and confer with the principals and professors of natural science of the various schools and colleges in the state, with naturalists and friends of natural science, with a view to the organization of local auxiliary societies, to the securing of local collections and the organization of a general system of exchanges, under the supervision of the Board of Directors.

Papers were presented to the society both at the June and the present meeting, by Prof. Marcy, of the Northwestern University, Dr. Vasey, Prof. Sewall, of the State Normal University, and Dr. F. Brendel, of Peoria.—*Prairie Farmer.*

NOTE.—The Editors desire *brief minutes*, such as those given above, of *every* meeting of all the Scientific Societies in North America. A copy of the NATURALIST will be sent to each Secretary, personally, free of expense, so long as such reports are promptly sent in to this office.

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THE MOSS-ANIMALS, OR FRESH WATER POLYZOA.

PLATE 3.

BY ALPHEUS HYATT.

Among all the creatures found in our pools and lakes, none are more pleasing to the eye when carefully examined, than the Moss-Animals. These delicate animal-flowers may be found in communities, expanding their shadowy plumes in the darker recesses of our ponds, attached to the under side of submerged sticks, logs and stones.

Figures 1, 2, and 3, in the plate, show three of these communities. In figures 2 and 3 the plumes are expanded, but in figure 1 they are withdrawn, as they always are when the colony is disturbed.

The moss-animals of our fresh waters are, with two exceptions, all members of one group, called Phylactolæmata, or animals with guarded throats; that is, having a little flap outside of the mouth, which guards this aperture. The two exceptions mentioned have not this characteristic, and, therefore, belong to the same division

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as their marine relatives, the Gymnolæmata, or Polyzoa with unguarded throats. Notwithstanding their harsh scientific name, the Phylactolæmata are light, elegant, mossy growths, and, when placed under a low power of the microscope, are even more beautiful than the flowers they resemble.

Their plant-like aspect, however, is a mere semblance, notwithstanding the branching mode of growth. If we examine any one specimen of the genus Fredericella, we speedily learn that the trunk is not a single, straight, solid stem, as in the plants, but made up of a series of minute, dark brown, tubular cells, arranged in a line, with the main branches and shorter twigs, also constructed of cells, arranged in a similar manner. Each cell (fig. 4) is a single animal, and contains the organs and muscles of one being, though so intimately attached to others, and so merged in the general life of the community, that it cannot, strictly speaking, be called an individual. An individual is but one animal, freely following the bent of its own will, and containing within itself an isolated, independent system of organs.

The lower portion of every cell is straight, being the continuation of the axis of the trunk, or branch of which it is a part; but the upper portion turns out of the direct line with an elbow-like bend, elevating one end above the stem. This end is free, and is surmounted by a transparent tube, which is closed by a round disc, perforated by the mouth, and bearing a crown of translucent, slender threads, called tentacles, which gracefully curve upwards like the petals of a lily (fig. 4, H). The tongue-like flap overhangs the mouth, and is continually jerked downward, instantly resuming its upright position, as if it were hinged on springs (fig. 5, I′). This is a most curious organ, and

although situated outside of the mouth (fig. 5, I''), it seems to answer many of the ordinary purposes of a tongue. It evidently discriminates between the different kinds of food, but is oftener employed to close the mouth over some struggling animalcule which obstinately refuses to be swallowed. It is a fleshy semicircular prominence formed by a fold of the disc (fig. 5, I), and is both the door of a trap, and an organ of taste combined.

The crown is interesting, not only on account of its beauty, and delicate transparency, but from the dreamy outline of each little thread, caused by the movements of the innumerable hairs investing them. The hairs, or cilia, themselves, are not visible, owing to their extreme tenuity, but the waves they make in the water can be plainly seen. So many thousands of these cilia are simultaneously moving upward on the outer sides of the threads, and downward upon their inner sides, that they force the water along in strong currents from the exterior down toward the bottom of the open-work vase where the mouth lies. The meeting of these currents coming from all sides at once, creates a whirlpool, in which hundreds of careless animalcules are continually caught and transported to the mouth. This being placed at the centre of the vortex catches all the objects entrapped by the current above, and it has, also, unfortunately for its helpless prey, a stomach beneath, which is indeed "an abyss no riches can fill." The thousands of sleepless cilia are day and night constantly in motion, drawing into the throat an endless stream of food. The stomach below is equally active, and thus all the organs work harmoniously, like machinery driven by steam, untiringly capturing and digesting the food, which, when assimilated, supplies the waste occasioned by the great activity of these parts. The threads

or tentacles, also prove useful in many other ways. They can twist together with incalculable rapidity, barring out any objectionable animal which may manifest a disposition to pry into the crown; or each one can by itself bend over and eject annoying particles; or, if the throat need a little cleaning, force its way down the tube and clear it, by pushing into the stomach whatever may be clinging to the sides. They are most amusing, however, in the angry pettishness they occasionally exhibit toward intruding neighbors. First comes an admonitory push, then a harder one, if the first is not successful, and lastly, unmistakeable blows administered with vicious rapidity by many threads in unison. Sometimes a "big fish" enters the crown in the shape of an animated speck, perceptible only when magnified twenty or thirty times its own size; then the sensitive tips of the threads curve together, and imprison the coveted morsel. Caged thus in a living net, and unable to break through the bars, it is soon exhausted by the power of the miniature maelstrom, and swept, in spite of many fruitless struggles, down into the gaping mouth.

On the exterior of the tentacles, reaching about half-way up their sides, is a thin veil, looped up and hanging gracefully between them like a delicate ruffle with pointed folds (fig. 4, G). Between this veil and the dark brown cell is the pellucid tube, and through its walls we can examine the internal organs. Directly under the tongue-like projection of the disc, or epistome, is the nervous mass, which takes the place of a brain in all the Polyzoa, (fig. 5, S). It has nerves leading to the throat, the stomach and intestine, besides two branches that go to the disc, and distribute those minute nervous tendrils, which endow them with such acute sensibility. The epistome,

or false tongue above the mouth, being only a fold of the disc, is hollow. The nerve-mass retreats into this cavity at will, probably by means of minute muscular fibres; and in this position, also, seeks security from injurious pressure, while the polyzoön is crowded within the shelter of its cell. Thus the epistome, in addition to its other multifarious uses, serves at times as a brain box.

The organs of digestion hang from the disc above, occupying the centre of the tube, and floating freely in the rapidly moving blood (fig. 5, K, K′, K″). The throat is closed at the lower end by a valve (fig. 5, K″), which opens into a gourd-shaped sack, the stomach; close by this is another valve which opens from the stomach into the intestine (fig. 5, K″″). The last is a canal leading up, side by side with the throat, for a short distance, but finally bending away from it, and opening externally through an aperture in the pellucid tube, just below the base of the ruffle, and not far from the mouth (fig. 5, $\overline{K}$).

Though the walls of these organs are variously tinted, they are not opaque, and, therefore, while not interfering materially with the view through the clearer substance of the tube, add greatly to its beauty. The yellowish throat, the stomach striped with dark brown, and the intestine, also dark brown, form a colored axis, giving a lifelike warmth to the airy delicacy of the surrounding film.

We have seen by what strange methods the food is captured, but this is not more curious than the way in which it is digested. A throatful, for we cannot say mouthful, is no sooner admitted to the stomach, than it is rolled up and down from one end to the other, with great violence. The walls of this organ take on a circular constriction, which pursues the morsel without intermis-

sion, forcing it first to one end, and then back again to the other, from which it entered, until the particles are all crushed and reduced to a pulp. These violent convulsions also serve another purpose; they squeeze the nutritious matter, resulting from digestion, out through the membranes of the stomach into the cavity of the tube and cell, where it becomes mingled with the blood, and is carried off to give health and strength to the body.

We have spoken of the plumes being withdrawn, in one of the colonies figured, and, though it has been only casually mentioned, this habit is the greatest obstacle to the observer while endeavoring to study their form. If the table be shaken ever so lightly, every unfolded crown vanishes, and often half an hour or more elapses before continued quiet allures them forth.

All the finely proportioned, transparent parts are balanced upon a fold of the wall of the tube (fig. 5, B), which is retained in its place inside of the cell by many muscles, like fine hairs, attached by one end to the fold, and by the other to the cell wall (fig. 4, N, N′, fig. 5, N). A continuation of the fold-membrane carpets the whole interior of the cell (fig. 4, 5, E), and to it are attached, near the lower end, the muscular fibres which drag the crown and the more delicate external parts into its shelter, at the approach of danger (fig. 4, M). The muscles are arranged in great broad bands rising in two trunks, each one spreading out above into numerous smaller branches. These branches are attached to the stomach, throat and disc near the mouth, and one of them to the wall of the tube not far from the base of the veil (fig. 4, M, M′, M″). They are diaphanous, but their delicate aspect is no measure of their strength. They jerk the crown and outer tube within the cell quicker than the eye

can follow them; and it is a curious fact, that after the movement is completed, and they are safely ensconced, the fibres are not content to rest, but still keep up a lively motion, writhing and twisting like bundles of minute worms.

The tentacles all the while lie gathered closely together in the sheath, formed for them by the tube, which has been doubled upon itself inside of the cell, like the finger of a glove inverted within the empty palm. When once more ready to emerge, the opening of the cell, which has been contracted by a circular band of muscle, like the mouth of a bag drawn up with a string, relaxes and permits the ends of the tentacles to protrude. These warily search for the cause of the previous alarm, and, if no hostile movements betray the presence of an enemy, the whole bundle slowly and cautiously follows, halts a moment, and then confidently unfolds its circlet of sentient threads. The Polyzoön reasons from the impression made upon these feelers, and cannot be induced to expose itself until thoroughly satisfied, by their exquisite sense of touch, that no danger lurks near its retreat.

Strange to say these plant-like creatures, singly mere animated pouches containing stomachs, show greater nervous sensibility than many more highly organized animals. They continually surprise us by actions which exhibit caution, fear, and anger to a remarkable extent, and imply a degree of complication in their relations, both social and physical, which the simplicity of the organization, and the limited sphere of its exercise render doubly interesting to the philosophical observer.

The wonders revealed in the structure of these lovely dwellers in the perennial shadows of our fresh waters, tempt one to linger, but the history of their circulatory

and respiratory functions, and their curious modes of reproduction must be deferred until the next number.

EXPLANATION OF PLATE 3. *Fredericella regina* Leidy.

Fig. 1, 2, and 3. Colonies attached to pieces of bark.

Fig. 4. Magnified view of one Polyzoön. D, brown envelope, the ectocyst; E, pellucid wall of the tube and cell, the endocyst; V, funiculus; M, M′, M″, upper branches of the muscles, the retractors; N, N′, muscles of the fold, the retentors; F, a small infolding of the endocyst, the brachial collar; G, the pointed ruffle, or calyx; H, the threads, or tentacles.

Fig. 5. Outline of the interior of part of a young specimen. Same letters as above, with the exception of B, the invaginated fold of the tube; Y, a very young polyzoön, a bud; K, the throat or œsophagus; H″, cilia surrounding the mouth; K‴, the valve opening into the stomach, œsophageal valve; K′, stomach; K⁗, intestinal valve partly open; K″, intestine; K̆, opening of intestine, the anus; I, disc, the lophophore; I′, the little flap, the epistome; I″, the mouth; S, nerve-mass.

Fig. 6. Side view of the top of a cell, with the tube and crown drawn within; letters same as before with the exception of A⁗, contracted orifice of the cell; L, position of muscular band, the sphincter.

Fig. 7. View of the same from above.

Fig. 8. Front view, showing upper branches of the retractors, which are attached to the wall of the tube and to the disc, M″ and M′.

THE FERTILIZATION OF FLOWERING PLANTS.

BY J. T. ROTHROCK.

It is now universally accepted by botanists that there exist distinct sexes in the vegetable kingdom, and that nature's method of maintaining the existence of a specific form, is to bring the male and female elements in contact. In a normal flower, the first group of organs we find inside the corolla, are the stamens; while the yellow powder, so frequently found inside of the swollen ends (anthers), is the pollen or male element. In the centre

HYATT ON THE MOSS ANIMALS.

of the flower we usually find one or more organs, called the pistil or pistils. The end or edge of this organ is called the stigma, which is generally more or less viscid. It is upon this viscid stigma that the pollen falls, or is conveyed by insects, the wind, or other agents. Soon a small tubule shoots out from the pollen grain; this tubule grows down through the stigma and style, into the ovary, where it comes in contact with the unfertilized ovule, which is then fertilized, and becomes capable of developing in its cavity an embryo that in time, and under favorable conditions, will become a perfect plant. In by far the greater number of flowering plants, we find both the male and female element in the same flower, or, in other words, such plants are hermaphrodites. One would naturally suppose that there could be but one object in thus placing the sexual elements in such immediate juxtaposition, namely, that each pistil might be fertilized by its own pollen or male element. Late researches have, however, made it evident that often even among plants, the nuptials cannot be celebrated without the intervention of a third party to act as a marriage priest, and that the office of this third person is to unite the representatives of different households. To be specific, seed capsules are most productive when their ovules are fertilized by pollen from another plant, or flower of the same plant. "Breeding in and in," can by absolute experiment, be proven to produce a degenerate offspring in the vegetable kingdom, no less than in the event of a marriage between first cousins in the human race.

Now the marriage priests who officiate in the vegetable kingdom are insects in search of honey; the winds, or anything which by accident, or design, may carry the pollen from one flower to another. How often do we

hear our agricultural friends complain, that they cannot succeed in keeping pure some choice varieties of vegetables, in consequence of the pollen from some common stock being wafted or carried to the pure variety, and thus contaminating it? Mr. Darwin has lately proven in the case of the genus *Linum*, or Flax, that though the stigma of a flower be completely dusted over with its own pollen, not one seed will be matured. This certainly was a "capital experiment." Though the impotency of pollen when applied to its own stigma is absolute in this case, we may not infer the line is always so sharply drawn. Facts contradict this; but a great step will have been taken in the right direction if we are taught to question many so-called instances of close fertilization. For example, most of us are familiar with the general habit of our common Laurel (*Kalmia*). We remember, also, that when in bloom, it shows us a waving sea of beautiful, rose-colored flowers, growing so closely together as to almost hide the leaves from view. When the flower first opens, we may observe that there is one small pocket in each angle of the flower, and that toward each of these pockets is bent backwards a stamen, so that an anther is included in each pocket. Every stamen represents a spring just ready to fly to a natural position of rest, when let loose. An insect in search of nectar lights on the flower, and in so doing jars the flower sufficiently to cause the stamen to spring up and converge over the stigma. Here, at once we say, the design is close fertilization. But not so fast. Pollen is often carried by the force of the spring to the pistil of an adjacent flower; and remembering the lesson taught us by the flax, we are not sure that pollen of one flower may not be prepotent when applied to the stigma of another flower, and so completely destroy close fertilization. We

do not say it *is* prepotent; any reader of the "Naturalist" may experiment for himself on the Kalmia. It is only offered here as a hint.

The field opened up by Mr. Darwin's experiments is new, and alluring, and perchance for that very reason may sometimes be so attractive as to lead us beyond the limits of sound reasoning, and reliable experiments. Yet there exists a group of plants in the study of which we may almost feel safe in giving a loose rein to our theories, for facts already ascertained, prepare us to believe nothing can be too strange to be true, in relation to the fertilization of this group. I allude to the so-called *dimorphic* plants; where the same species presents two distinct forms, one with long stamens and short pistils; the other with short stamens and long pistils. Now it has been proven in the case of the Flax, and of the Primrose, that the most fertile union is that which results from the impregnation of the long-styled forms by the pollen of the short-styled, and the reverse. Some experiments made by myself, at the suggestion of Prof. Asa Gray, convince me that the same applies in a remarkable degree to our common little Spring Beauty (*Oldenlandia*), or, as it is commonly called, Innocence or Bluets.*

This differentiation of the specific form, may even go farther, and give us trimorphic plants. I cannot better illustrate what I mean, than by quoting at length, though at second hand, from Mr. Darwin's paper, "On the Sexual Relations of the three forms of Lythrum salicaria."

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*In Oldenlandia we find an evident structural differentiation of both pollen and stigma. The relative length of the stamens of one form when compared with that of the style of the other form, almost drives one to the conclusion that the design, in this case, is to secure cross-fertilization. I have frequently observed a species of Thrips crawling about from flower to flower, with its back completely dusted over with pollen.

"In Lythrum salicaria (Spiked Loosestrife) three plainly distinct forms occur; each of these is an hermaphrodite; each is distinct in its female organs from the other two forms; and each is furnished with two sets of stamens or males, differing from each other as much as if they belonged to different species; and if smaller functional differences are considered, there are five distinct sets of males. Two of the three hermaphrodites must co-exist, and the pollen be carried by insects reciprocally from one to the other, in order that either of the two should be fully fertile; but, unless all three forms co-exist, there will be a waste of two sets of stamens, and the organization of the species as a whole will be imperfect. On the other hand, when all three hermaphrodites co-exist, and the pollen is carried from the one to the other, the scheme is perfect; there is no waste of pollen and no false co-adaptation. In short, nature has ordained a most complex marriage arrangement, namely, a triple union between three hermaphrodites, each hermaphrodite being in its female organ quite distinct from the other two hermaphrodites, and partially distinct in its male organs, and each is furnished with two sets of males."

It farther appears, "that only the longest stamens fully fertilize the longest pistils, the middle stamens the middle pistil, and the shortest stamens the shortest pistil. And now we can comprehend the meaning of the almost exact correspondence in length between the pistil of each form, and the two half dozen sets of stamens borne by the two other forms; for the stigma of each form is thus rubbed against that spot of the insect's body, which becomes most charged with the proper pollen."

Mr. Scott has led us to adopt a new clause in our scientific creed, and one, which, did it not come properly

vouched for, might well cause a rising doubt. He tells us that the pollen of one species of Passion Flower will fertilize the ovules of another species, though the ovules of the first may not in turn be fertilized by the pollen of the second. Thus Tacsonia mollissima will fertilize the ovules of Passiflora racemosa, but Passiflora will not fertilize Tacsonia.

Interesting as may be the means resorted to in the cases above mentioned, to secure cross-fertilization (mostly through the medium of insects) they yield in fascination to the adaptations by which the same results are accomplished by the same agents in many Orchids.

We must refer those who wish to go into the details of fertilization, as it is brought about in this gorgeous family, to Mr. Darwin's interesting volume on "Fertilization of Orchids by Insects." They will there find the subject treated of by a master mind in such inquiries. The temptation to meddle in work so much better done elsewhere, is too great, and we should be surprised at ourselves if we passed the subject entirely by. Among the Orchids and Milkweeds (*Asclepias*), we find that the pollen, in place of being loose, or at the most slightly coherent, is here neatly done up in two small decanter-shaped packets, which are connected at the top of the necks by a small, viscid gland.

Let us imagine that on some bright summer morning, a humble bee, for example, happening to be out in search of the material from which to get its store of honey, alights on one of these Orchids. Standing, perchance, on the large lip (so prominent among these flowers), it dips its head down to the bottom of the flower in search of nectar. The chances are ten to one that its forehead strikes directly upon this viscid gland connecting the two

packets of pollen. By the time the nectar is exhausted the gland has become adherent to the bee's head, and as it (the head) is withdrawn, the two pollen masses are extracted from their pockets, and now stand off in front like a pair of horns. The bee, most likely, flies to another plant of the same species, or still more probably to another flower of the same plant. Suppose the stigmatic surface of this species of plant be broad, or possibly separated almost into two parts; we will find the packets have slowly but surely diverged so as to be the exact width of that surface. Suppose on the other hand, the stigma be a narrow one, we shall find that the packets have come close together. In either case when the bee's head bobs down into the next flower, it will almost certainly happen that these same pollen masses will be left sticking on the stigma when the bee leaves, or at least part of the pollen will be left. These masses of pollen have long since been frequently observed on the bee's head, but, until quite lately, no meaning had been attached to it. Some entomologists, I believe, have even been guilty of describing these as natural appendages to the bee's head. So manifest are these adaptations for the purpose of cross fertilization among Orchids, that we may be well nigh sure some great purpose is to be subserved. Perhaps it would not be too much to say, that but for insect agency many Orchids would become extinct. There are not wanting those who even affirm the insect shape assumed by some Orchidaceous flowers, has no less purpose than to serve as a decoy, and thus tempt the bee or butterfly to alight upon them and accomplish the work of fertilization. Those wishing to be apprized of the mode of fertilization, as it occurs in our American plants, will find some admirable articles from the pen of Prof. Asa Gray, in Silliman's Journal

for 1862. Robert Brown long since called attention to insect agency, in the fertilization of the Milkweed family. Almost any summer day we may repeat his observations for ourselves. So adhesive are the glands of the Asclepias obtusifolia (Wavey-leaved Milkweed), that we often find honey bees unable either to withdraw the packets, or loose their feet from the gland, and thus they become prisoners for life.

There exists yet another class of dimorphic flowers, in which we find the large and more conspicuous flowers less fertile than those of the other form, which are arrested in their development, and are fertilized in the bud. Hugo van Mohl has of late called especial attention to them. Such flowers have been happily termed precociously fertilized. Mohl concludes, after close examination of Viola, Oxalis, Specularia and Impatiens, that nature is here specially solicitous to secure close breeding, or that each flower shall be fertilized by its own pollen. He calls attention also to the fact, that in the large anthers of the smaller form of Oxalis acetosella, not more than two dozen pollen grains are found, while in the anthers of the larger form they are much more numerous. In the smaller form, however, the few grains are made more potent, and the exercise of their function is secured, by being placed in contact with the stigma. It results, however, that our list of closely fertilized plants is becoming smaller, under the repeated observations of accurate investigators, and that, what was supposed to be a special adaptation to secure close fertilization, is, after all, but a more nicely conceived method of obtaining an opposite result. For example, we were formerly taught that the interior petals of Corydalis clasped the anthers and stigma of the flower in so tight an embrace that outside fertilization

was a thing not to be thought of. Dr. Hildebrand informs us however, that though the stigma of Corydalis cava be completely dusted over with pollen from the same flower, yet no seed will set if insects be excluded from carrying pollen from flower to flower. This fact is, as will be observed, another illustration of Mr. Darwin's law of prepotency of pollen taken from one flower, and applied to another. Professor Gray also calls attention to the "effectual activity of so large an insect as the bumble-bee in fertilizing our Corydalis aurea" (Golden Corydalis).

Just now we can point to but one instance in which a plant of high order is found to produce perfect embryos, without the ovules having been previously fertilized according to the known method. In the Kew Gardens, near London, has been kept for many years a plant of the Spurge family, which furnishes this one example. Dr. Hooker writes to Humboldt concerning it, as follows: "Our Cœlebogyne still flowers with my father at Kew, as well as in the Garden of the Horticultural Society. It ripens its seeds regularly. I have repeatedly examined it with care, but have never been able to discover a penetration of pollen utricles into the stigma, nor any traces of their presence in the latter or in the style." This plant belongs to the old Linnæan class Diœcia. It is unisexual, and as there exists only (so far as known) the female plant in England, it is difficult to conceive how the fertilization is accomplished, unless through the agency of concealed anthers. Though diligent search has been made time and again for the anthers, they do not seem to have been found. We may still fairly hesitate before accepting this as an example of parthenogenesis, or virgin fertility.

INSECTS AND THEIR ALLIES.

BY A. S. PACKARD, JR., M. D.

That branch of the Animal Kingdom known as the ARTICULATA, is so called from having the body composed of rings or segments, like short cylinders, which are placed successively one behind the other. Cuvier selected this term because he saw that the plan of their entire organization, the essential features which separate them from all other animals, lay in the idea of articulation, the apparent joining together of distinct segments along the line of the body. If we observe carefully the body of the Worm, we shall see that it consists of a long cylindrical sac, which at regular intervals is folded in upon itself, thus giving a ringed, annulated or articulated appearance to the body. In the Crustacea (Crabs, Lobsters, etc.) and in the Insects, from the deposition of an earthy salt, called *chitine*, the walls of the body become so hardened, that when the animal is dead and dry, it readily breaks into numerous very perfect rings.

Fig. 1.

Worm-like larva of a Fly, *Thereva?*

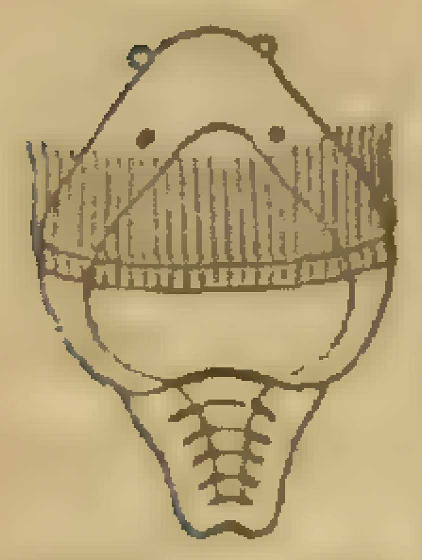
Though this branch contains a far greater number of species than any other of the animal kingdom, their myriad forms can all be reduced to a simple, ideal, typical figure; that of a long slender cylinder divided into numerous segments, as in Fig. 1, representing the larva of a Fly. It is by the unequal development and the various modes of grouping them, as well as the differences in the number of the rings themselves, and also in the changes of form of their appendages, i. e., the feet, jaws, antennæ and wings, that the various forms of Articulates are produced.

In all Articulates the long, tubular, alimentary canal occupies the centre of the body; above it lies the "heart,"

or dorsal vessel, and below, upon the under side, rests the nervous system. The breathing apparatus, or "lungs," in Worms consists of simple filaments, placed on the front of the head; or of gill-like processes, as in the Crustacea, which form simple expansions of the legs; or, as in the Insects, of delicate tubes (*tracheæ*), which ramify throughout the whole interior of the animal, and connect with breathing pores (*stigmata*) in the sides of the body. They do not breathe through the mouth as do the higher animals. The tracheæ and blood-vessels follow closely the same course, so that the aëration of the blood goes on, apparently, over the whole interior of the body, not being confined to a single region, as in the lungs of the vertebrate animals.

Thus it is by observing the general form of the body-walls, and the situation of the different anatomical systems, both in relation to themselves and the walls of the body, or crust, which surrounds and protects the more delicate organs within, that we are able to find satisfactory characters for isolating, in our definitions, the articulates from all other animals.

Fig. 2.



Young Terebella, soon after leaving the egg. A. AGASSIZ.

We shall perceive more clearly the differences between the three classes of articulates, or jointed animals, by examining their young stages, from the time of their exclusion from the egg, until they pass into mature life. A more careful study of this period than we are able to enter upon at present, would show us how much alike the young of all articulates are at first, and how soon they begin to differ, and assume the shape of their class.

Most Worms, after leaving the egg, are at first like some infusoria, being little sac-like animalcules, often ciliated over nearly the entire surface of the infinitesimal

body. Soon this sac-like body grows longer, and contracts at intervals; the intervening parts become unequally enlarged, some segments or rings, formed by the contraction of the body-walls, greatly exceeding in size those next to them; and it thus assumes the appearance of a being, more or less equally ringed, such as in the young Terebella, here figured, where the ciliæ are restricted to a single ring surrounding the body. Gradually the ciliæ disappear and regular locomotive organs, consisting of minute paddles, grow out from the side; feelers (antennæ), jaws, and eyes (simple rudimentary eyes) appear on the few front rings of the body, which are grouped by themselves into a sort of head, though it is difficult in a large proportion of the lower worms, for unskilled observers to distinguish the head from the tail. In the embryo of the Crustacean, such as the Fresh-water Crawfish, as shown by the German naturalist Rathke; and also in the earliest stages of the Insect, the body *at once* assumes a worm-like form, thus beginning its embryonic life from the goal reached by the adult worm.

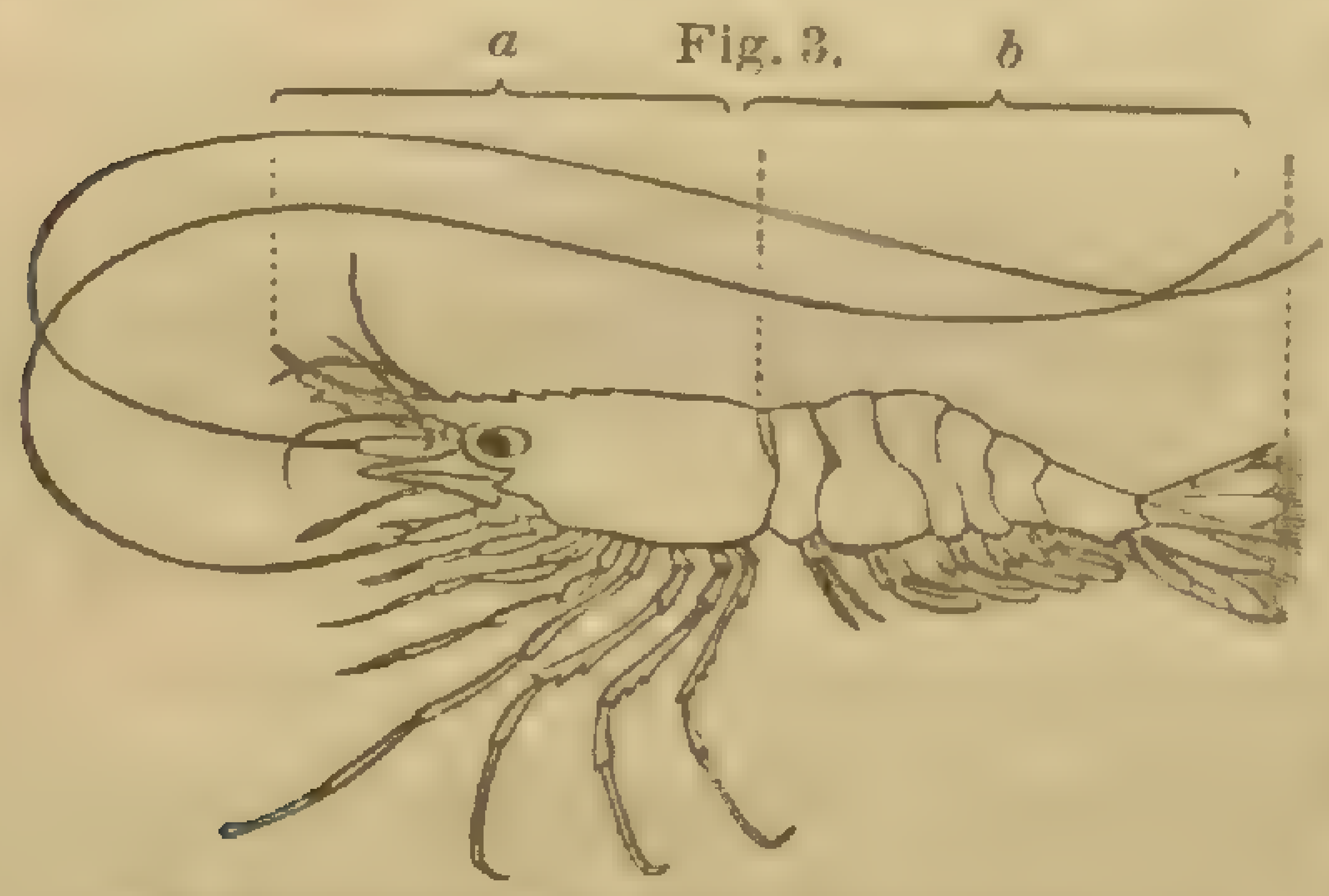
Thus we see throughout the growth of the worm, no attempt at subdividing the body into regions, each endowed with its peculiar functions; but only a more perfect system of rings, each relatively very equally developed, but all becoming respectively more complicated. For example, in the fresh-water Nais, each ring is plainly distinguished into an upper and under side, and in addition to these a well marked side-area, to which, as in the marine worm, *Nereis*, oar and paddle-like organs are attached; in most other worms eye-spots appear on the front rings, and slender tentacles grow out, and a pair of nerve-knots (*ganglia*) are apportioned to each ring.

Thus, in the Worm the vital force is very equally distrib-

uted to each zoölogical element, or ring of the body; no single part of the body is much honored above the rest, so as to subordinate and hold the other parts in subservience to its peculiar and higher ends in the animal economy.

But when we rise in the scale of articulate life, we see at once the action of a new principle. First in the Crustacean appears a broad distinction between the front and posterior end of the body. The rings are now grouped into two regions, and the hinder division is subordinate in its structure and uses to the forward portion of the body. Hence the nervous power is transferred in some degree towards the head. The organs performing the functions that distinguish animals from plants, such as locomotion and sensation, all reside in the front region; while the vegetative functions, or those concerned in the reproduction and nourishment of the animal produced, are mostly carried on in the hinder region of the body (the abdomen).

Fig. 3.



Pandalus annulicornis Leach. A Shrimp.
a. cephalothorax; *b*. abdomen.

The Crustacean cannot be said to have a true head, in distinction from a thorax bearing the organs of locomotion, but rather a group of rings, to which are appended the organs of sensation and locomotion.

Sometimes the jaws become remarkably like claws; or the legs resemble jaws at the base, but towards their tips become claw-like; gill-like bodies are sometimes attached to the foot-jaws, and thus, as stated by Prof. J. D. Dana, in the introduction to his great work on the Crustacea of the United States Exploring Expedition, the typical Crus-

tacea do not have a distinct head, but rather a "head-thorax" (*cephalo-thorax*).

When we rise a third and last step into the world of Insect forms, we see a completion and final development of the articulate plan which has been but obscurely hinted at in the two lowest classes, the Worms and Crustacea. Here we first meet with a true head, separate in its structure and functions from the thorax, which, in its turn, is clearly distinguishable from the third region of the body, the abdomen, or hind-body. These three regions, as seen in the wasp, are each provided with three distinct sets of organs, each having distinct functions, though all are governed by, and minister to the brain force, now in a great measure gathered up from the posterior rings of the body, and in a more concentrated form (the brain), lodged in the head.

Fig. 4.

Philanthus ventilabris Fabr. A Wood-wasp. From SAY.

Here, then, is a centralization of parts headwards; they are brought as if towards a focus, and that focus the head, which is the meaning of the term "cephalization," proposed by Professor Dana.* *Ring* distinctions have given away to *regional* distinctions. The former characterize the Worm, the latter, the Insect. In other words, the division of the body into three parts, or regions, is in the insect, on the whole, better marked than the division of any one of those parts, except the abdomen, into rings. This is

* In two papers on the Classification of Animals, published in the *American Journal of Science and Arts*, Second Series, vol. xxxv, p. 65, vol. xxxvi, July 1863, and also in his earlier paper on Crustaceans, "the principle of cephalization is shown to be exhibited among animals in the following ways:—

1. By a transfer of members from the *locomotive* to the *cephalic* series.
2. By the anterior of the locomotive organs participating to some extent in cephalic functions.
3. By increased abbreviation, concentration, compactness, and perfection of structure, in the parts and organs of the anterior portion of the body.
4. By increased abbreviation, condensation, and perfection of structure in the posterior, or gastric and caudal portion of the body.
5. By an upward rise in the cephalic end of the nervous system. This rise reaches its extreme limit in Man."

well illustrated in the thorax of the Wasp. In reality the thorax of this insect consists of three rings, with a supernumary one—the first and basal ring of the abdomen—thus forming a compact mass, consisting of four of these rings. But all are so intimately united into an almost spherical, rounded mass, which is due to the unequal size of the parts composing the rings, some being enlarged, and others either diminished in size, or wholly wanting, that it needs the sagacity of a Latreille, or an Audouin, those fathers of Entomology, to detect the actual number of the elemental rings.

Appended to the head, as the legs to the thorax, are special organs of sight and touch, into which the brain is immediately projected; as the simple and compound eyes, and the antennæ, each with their separate pair of nerves. These are placed in front of the mouth. Behind the mouth, and on each side, are the jaws or mandibles, the maxillæ with their palpi (or touchers), and last of all, and next to the thorax, the labium, or under lip, and its palpi. Before the larva leaves the egg, these four pair of appendages are much alike in form, budding out as simple tubercles, and their relative position and succession are as given above; but during growth they change their position, crowd forward about the mouth-opening, so as to lose nearly all traces of their normal succession, and, in consequence, the labial palpi seem to be more properly placed in advance of the maxillæ, while the mandibles appear, on their part, to be inserted at the base of the head next to the thorax; and it is only by tracing their origin and development, as given in the works of Claparède and Weismann, which we shall farther notice in this journal, that we have been able to understand their normal position.

Insects, as a whole, are much smaller than the Crustacea; for example, compare a Honey bee or Hawk moth with a Lobster or Crab. This diminution of size is due to the greater concentration of parts, and their compression into a much less bulk. Crustacea are mostly inhabitants of the water, while Insects are, in some form, almost exclusively terrestrial. As the Whale exceeds in size the Dog or Lion, or Man himself, so does the Lobster surpass in bulk the Bee, though the latter is a much more highly organized animal, with a more complicated outer crust, a more complex system of nerves, bloodvessels and muscles.

There are various grades of superiority among insects. Rank among men is determined by one's superior intelligence, and less and less likeness to the savage. Thus writers on Ethnology place the European and Australasian at two extremes. On this principle the zoölogist classifies animals by their greater or less resemblance to the lowest types. Thus among Articulates, the Worms are the simplest in form, and in all respects the lowest. The Crustacea are placed next in the natural system, which leaves the Insects topping the series. In classifying the subdivisions of the class of Insects, we observe the same principle. In locating an Insect in what seems to us its true place within its own group, we must follow this rule, i.e., its greater or less resemblance to the typical wormlike form, for the more the body is developed *headwards* the higher is its rank. Among the lowest Insects are the May-flies (*Ephemera*), the Panorpa, or Forceps-tail, and the Spring-tails (*Podura* and *Lepisma*). In these forms the body is slender and wormlike, and the head is many times smaller than the rest of the body. In the Honey bee however, which is the highest among all articulates, the head is but little smaller, and yet very distinct from

the thorax; which again, is but a little smaller than the abdomen. In the Bee, more than in other insects, the rings, or parts of rings remaining after the growth of the animal has been completed, are more equally developed than in the lower insects—no single part attains a monstrous development over the other, as in the May-fly or Dragon-fly. The Bee, of all insects, performs the most varied and complex intellectual acts; in its immense colonies—a rude foreshadowing of human republics—are portioned out to the Queen, the Worker and the Drone, special duties in the insect economy. How varied those duties are, how readily a Worker will perform some acts rarely or never before attempted, and how ready these insects, and their allies, the Ants, are to adapt themselves to new and untried circumstances, all Bee keepers and entomologists are well aware.

Fig. 5.

Ephemera, May Fly.

Let us for a moment look more closely at the tough parchment-like crust of the Insect. We shall then better understand what has been said of its complexity. We find that each ring when examined by itself, consists of an upper (*tergite*), and under (*sternite*), and side-pieces (*pleurite*, consisting of the *epimerum* and *episternum*). These sections of a circle rest on each other, giving the greatest strength and resistance to the whole ring. In the perfect insect the simplest form of the elemental ring is found in the abdomen. The upper and lower arcs are nearly equal in size, and the side-piece is also well mark-

Fig. 6.*

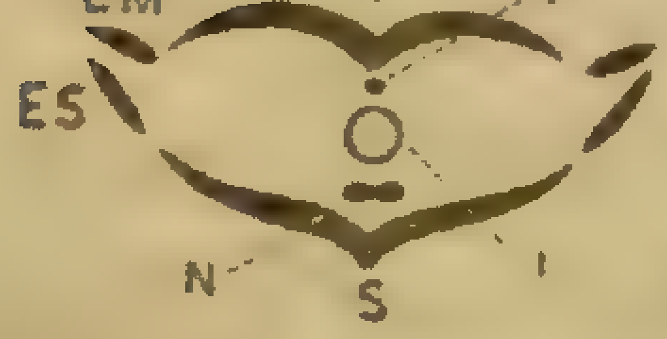


*Fig. 6. Section of an abdominal segment of an hemipter, *Ranatra*. T. tergum; S. sternum; EM. epimerum; ES. episternum; N. nervous system; I. alimentary canal; V. dorsal vessel. L. DUTHIERS.

ed, as seen in the body of the caterpillar. When, however we turn to a thoracic segment, the relative size of the pieces is very unequal, the side-pieces being much larger than the upper or under piece, especially in the Dragon-fly, which is ever on the wing. In the Libellula, the upper part of the ring is greatly reduced in size, and the larger part of the ring consists of the side-pieces. As a rule, however, the under piece (*sternum*) is very small, the dorsal or upper-piece (*tergum*) is well developed, while the side-pieces are increased in a still greater ratio, as seen in the Wasp, which walks and also flies with ease. The side, or limb-bearing part of the ring, is generally largest in the running insects, as in the Beetles, of which *Carabus*, the Ground-beetle, is a type. On the other hand the dorsal (or *tergal* piece, the more technical name, since the word dorsal is more appropriate in speaking of the vertebrates, or animals with a back bone) part of the ring is quite small in the Dragon-fly and its allies. In these insects, which scarcely ever walk, merely using their legs in clinging to plants when resting from their long sustained flights, the side-pieces are disproportionately enlarged over the other parts of the ring, for the purpose of affording broad attachments to the muscles of flight.

To the side pieces all the appendages, such as the legs and wings, are attached. In order that the legs may move freely on the body, and thus give play to hundreds of minute muscles within the legs, these side pieces are subdivided into several smaller sections. Were this not so, and the crust forming the exterior of the insect unbroken, thus forming a continuous series of cylinders, we should have the poor victims of this stern law of morphology enclosed in jackets of the straightest sort!

Whence comes, then, all the grace and perfect freedom of action seen in the vivacious motions of the Ichneumon fly and Butterfly? It lies in the fact that the whole outer crust is subdivided into portions which are finely hinged together by a tough membrane, forming points of attachment to thousands of little muscular fibres within, and thus giving the otherwise rigid crust a surprising degree of flexibility.

The three pair of legs are inserted at the lower edge of the side-piece (episternum, Fig, 6, ES), as seen in the figure, and the wings grow out between the upper side piece, (Fig. 6, EM) and the tergum (Fig. 6, T). The body of all known insects consists normally of twenty of these cylindrical rings, each of which is theoretically subdivided in the manner we have shown; but towards each extremity of the body, as in the rings composing the head and tail, but a part of the ring is developed, since the remaining portions have, during the development of the animal, either while still in the egg, or during its growth afterwards, become absorbed, and have consequently disappeared. In the head of all insects there are, as a rule, seven such rings, in the thorax three, and in the hind body, or abdomen, at least ten, and perhaps eleven, elemental segments. Counting, in addition to the great number of pieces which compose the trunk, the numerous joints of the legs, and those of the antennæ, which approach in the Cockroach to nearly a hundred in number, we can form some idea of the exceeding complexity of the insectean crust. Thus descriptive entomology has to take account of several hundred distinct parts, which by their relative size and position, produce the immense range of variation existing in nearly half a million species which are estimated to be scattered over the face of the earth,

besides those entombed in its crust, as fossils, which can never be numbered.

Thus the idea of articulation, upon which Cuvier founded this branch of the animal kingdom, which begins so simply in the worm and grows far more complex in the crab and its allies, is, in the insect, carried out with a bewildering richness and profusion of detail. It is like comparing a savage's "dug out" to the "Great Eastern" steamship, or the rude wigwam of an Indian to the Cathedral of Milan.

The German Naturalist Oken, who in his writings has so often anticipated the results of subsequent laborious inquiries, said in his aphoristic style when discoursing of insects: "Every fly creeps as a worm out of the egg; then by changing into the pupa, it becomes a crab, and, lastly, a perfect fly." The motions of these worms and crabs to which he aptly compares the two stages of the young fly, will show a farther analogy, though to many it may seem fanciful, between these forms of jointed animals. Worms wriggle along as they move. Now wriggling is one of the lowest forms of locomotion. The waddling of geese partakes of the same nature. In worms,,the many rings of the body, so similar to each other in form and size, move on themselves, and then move all together, and thus the creature progresses. In pupæ the abdomen moves upon the forward part of the body; the insect *jerks* about by the motive power residing in the abdomen. Here is indeed a localization of the power of motion, and something is gained in the rising scale. Now the Crustacea, or crabs and their allies, all move by jerking. Watch the microscopic Cypris or larger Cyclops, in its swift circumnavigation of a drop of water. It moves both by its thoracic legs, and by the locomotive

power of its abdomen or hind-body, as it swims through its little "world of waters" by jerks. So also the Amphipod, a crab-like being, higher in the scale than the water flea, darts from weed to weed in the clear cool waters of tidal pools, by most gracefully jerking its abdominal rings. So also the clumsy crab clambers cautiously obliquely backwards over the pebbles by a jerking sort of gait; and the lobster carelessly bends its tail beneath its breast, and like a flash, lands softly a fathom away, in its course leaping the Laminaria swaying to and fro in the ebbing tide.

Compare with these stiff and clumsy motions, the flight of a swallow-tailed Butterfly, as it emulates all the motions of an eagle in its majestic flight over forests and through sequestered glades. The lowest of butterflies, the small dun colored Hesperiadæ, or Skippers, *jerk* as they fly. Or compare again the swift, vivacious, inquisitive motions of an Ichneumon fly, just as it has alighted upon a leaf. See the intensity of life in every movement of its open, restless wings; the head turning this way and that, with the vibrating feelers and threadlike waving antennæ, prompted by the nervous energy within; its arching abdomen directing each incessant and swift darting movement of its ovipositor, while running from leaf to leaf in its anxious search for some unlucky caterpillar in which to lay its eggs. In this tiny insect is a specialization of motion in every limb and section of its body, to which no lower articulate can attain.

Thus we see a certain degree of correspondence between the various modes of locomotion of the different groups of animals and their position in nature.

THE AMERICAN SILK WORM.

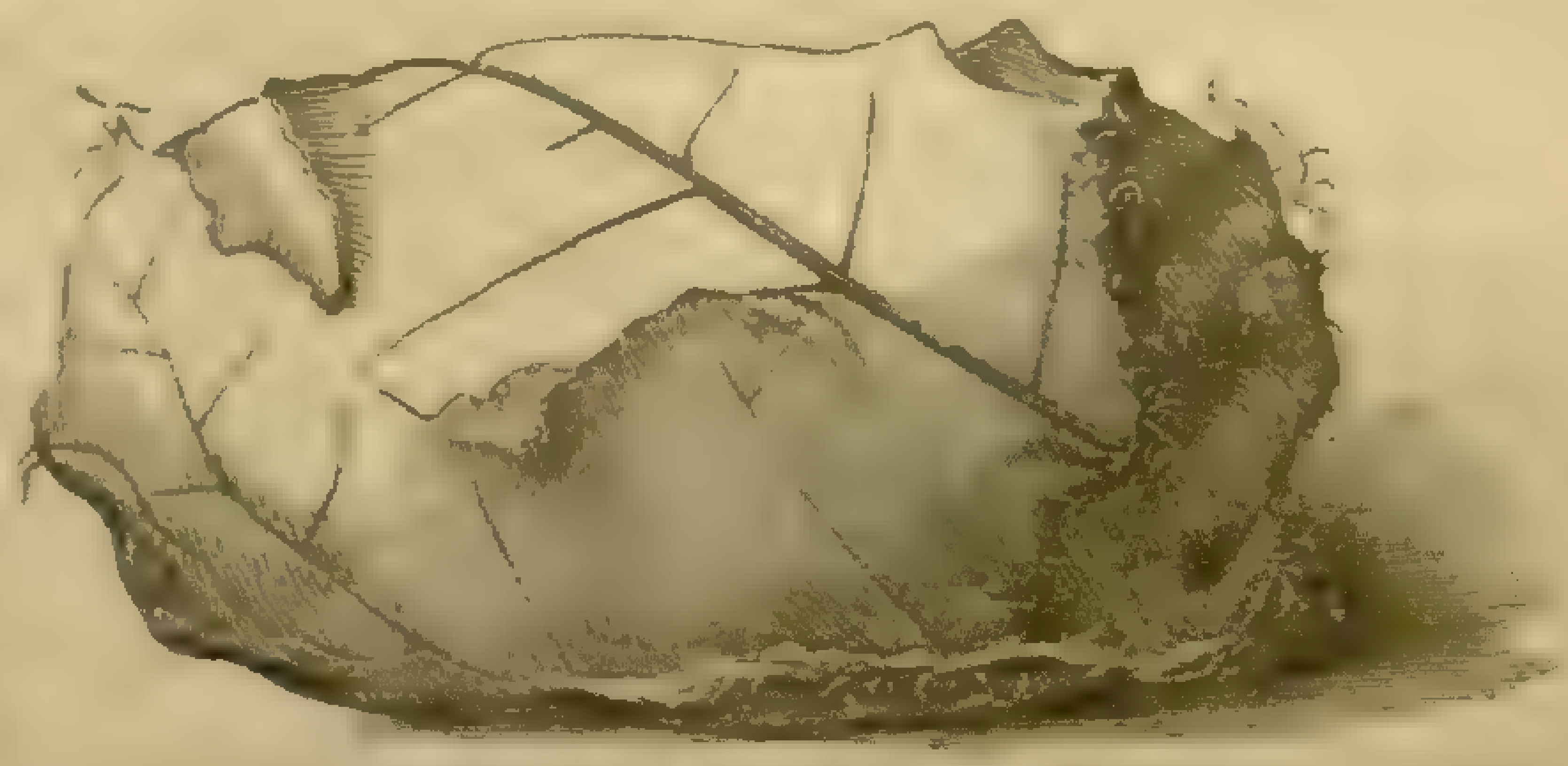
BY L. TROUVELOT.

(Continued from page 38.)

It is astonishing how rapidly the larva grows, and one who has no experience in the matter could hardly believe what an amount of food is devoured by these little creatures. One experiment which I made can give some idea of it: when the young silk worm hatches out, it weighs one-twentieth of a grain; when

10	days	old	it	weighs	½	a grain,	or	10	times	the	original weight.
20	"	"	"	"	3	grains	"	60	"	"	"
30	"	"	"	"	31	"	"	620	"	"	"
40	"	"	"	"	90	"	"	1800	"	"	"
56	"	"	"	"	207	"	"	4140	"	"	"

When a worm is thirty days old it will have consumed about ninety grains of food; but when fifty-six days old it is fully grown and has consumed not less than one hundred and twenty oak leaves weighing three-fourths of a pound; besides this it has drank not less than one-half an ounce of water. So the food taken by a single silk worm in fifty-six days equals in weight eighty-six thousand times the primitive weight of the worm. Of this, about one-fourth of a pound becomes excrementitious matter; two-hundred and seven grains are assimilated and over five ounces have evaporated. What a destruction of leaves this single species of insect could make if only a one-hundredth part of the eggs laid came to maturity! A few years would be sufficient for the propagation of a number large enough to devour all the leaves of our forests.



Cocoon of *Telea Polyphemus*.

When fully grown, the worm which has been devouring the leaves so voraciously, becomes restless and crawls about the branches in search of a suitable place to build up its cocoon; before this it is motionless for some time, holding on to the twig with its front legs, while the two hind pair are detached; in this position it remains for some time, evacuating the contents of the alimentary canal until finally a gelatinous, transparent, very caustic fluid, looking like albumen, or the white of an egg, is ejected; this is a preparation for the long catalepsy that the worm is about to fall into. It now feels with its head in all directions, to discover any leaves to which to attach the fibres that are to give form to the cocoon. If it finds the place suitable, it begins to wind a layer of silk around a twig, then a fibre is attached to a leaf near by, and by many times doubling this fibre and making it shorter every time, the leaf is made to approach the twig at the distance necessary to build the cocoon; two or three leaves are disposed like this one, and then fibres are spread between them in all directions, and soon the ovoid form of the cocoon distinctly appears. This seems to be the most difficult feat for the worm to accomplish, as after this the work is simply mechanical, the cocoon being made of regular layers of silk united by a gummy substance. The silk is distributed in zig-zag lines of about one-eighth of an inch long. When the cocoon is made, the worm will have moved his head to and fro, in order to distribute the silk, about two hundred and fifty-four thousand times.

After about half a day's work, the cocoon is so far completed that the worm can hardly be distinguished through the fine texture of the wall; then a gummy resinous substance, sometimes of a light brown color, is

spread over all the inside of the cocoon. The larva continues to work for four or five days, hardly taking a few minutes of rest, and finally another coating is spun in the interior, when the cocoon is all finished and completely air tight. The fibre diminishes in thickness as the completion of the cocoon advances, so that the last internal coating is not half so thick and so strong as the outside ones.

During the process of spinning, the worm contracts and diminishes in size, as the silk reservoirs empty. Six or eight days after the beginning of the cocoon, the worm casts its last larva-skin, and then appears under a very different form—a transitory one, which is neither worm nor moth; it is the chrysalis or pupa. When the chrysalis comes out of the larva skin, if observed closely, it will be seen that its resemblance to the perfect insect is striking;

Pupa of *Telea Polyphemus.*

the antennæ, the head, the legs and abdomen resemble very much those of the moth. The wings only, are very small, but in a few minutes they grow to about half the size of the abdomen. The legs of the chrysalis, at least the tarsi, are enclosed in the articulated leg of the larva, the wings are folded under the skin of the second and third segments, and the antennæ are rolled up in the lobes of the cranium. When the chrysalis comes out, every part is detached and free, and if then put in alcohol they will remain so; but when left to its natural course it will soon be observed that a general envelope covers the whole chrysalis, and that any motion of the legs, wings and antennæ is impossible, since the insect is contained in the hard brownish envelope secreted by its tegument, and

now resembles an Egyptian mummy. If before the shell of the pupa has become hard, an antenna, a leg or a wing be changed from the position that the insect has given to it, that part of the body which would otherwise have been covered by the part removed out of place, will remain of a different color and of a thinner consistence, and an insect thus treated will not generally live to arrive at the imago state.

Before the last transformation is accomplished, the insect takes a long rest, and this period is the longest of its life; if it can be called an existence to live without eating, breathing, or even, probably, without having any distinct sensation. The pupa spends about nine months in this torpor, and braves the hardships of winter, notwithstanding all the changes of the temperature, being frozen as hard as a stone. It is only when the warm spring days come that life awakens, and the pupa is transformed into a perfect insect.

If a worm be opened longitudinally, even when half grown, there will be found in the female a vast number of little globular white bodies attached to a fine tube on each side of the stomach. These little bodies are the eggs of the future female moth, as yet in a rudimentary state. This is the only method of distinguishing the female from the male, while in the larva state. I have never been able to find any other character by which to distinguish the sexes. Again on making the same dissection of the larva, there will be found on each side of the stomach, and running from head to tail, two long secretory reservoirs, making a great many convolutions. These are the silk reservoirs. The transparent liquid they contain is the silk, as yet in a liquid state. If one of these vessels be taken out carefully and stretched, it will mea-

sure twenty five inches in length; these two reservoirs become very narrow as they approach the mouth, and unite together, terminating in a special contractile organ, attached beneath the mouth. When spinning, the silk is thrown out from the two reservoirs at the same time, and the thread is in reality composed of two distinct fibres which can be easily separated.

The silk in the reservoirs is sometimes used in commerce, being sold under the name of "gut." The process of obtaining the gut is very simple; it consists in preparing worms ready to spin by putting them in strong vinegar for eighteen hours; a transverse opening is then carefully made on the under side and about the middle of the body, taking care not to injure the silk reservoirs which are very distinct. The glands, or reservoirs, are then taken out and stretched parallel to each other on a board, and dried in the shade for several days.

The Enemies of the Silk Worm. Birds are the most formidable foes to the silk worm, especially the Thrushes, Cat-birds and Orioles. It is probable that ninety-five out of a hundred worms become the prey of these feathered insect-hunters. Toads and snakes also destroy some, and mice, rats, moles and squirrels eat the chrysalis enclosed within the cocoon. Among insects they have many enemies, such as various spiders, ants, bugs and wasps; but their most

Ophion macrurum Linn. Ichneumon Parasite on the larva of *Telea Polyphemus.*

dangerous foe is the Ichneumon fly. A Tachina-like fly also deposits its eggs in the body of the larva. The Ichneumon flies can be seen in summer flying about bushes in search of caterpillars in which to deposit their eggs, and I have observed them often flying for an hour among shrubs where no worms were feeding, for which they searched carefully, peering under almost every leaf. When an Ichneumon detects the presence of a worm, she flies around it for a few seconds, and then rests upon the leaf near her victim; moving her antennæ very rapidly above the body of the worm, but not touching it, and bending her abdomen under the breast, she seizes her ovipositor with the front legs, and waits for a favorable moment, when she quickly deposits a little oval white egg upon the skin of the larva. She remains quiet for sometime and then deposits another egg upon the larva, which only helplessly jerks its body every time an egg is laid on it. She thus lays some eight or ten eggs which adhere so firmly to the skin, that it is very difficult to take them off. After several days these eggs hatch out, and the small white larvæ may be seen at work as soon as they are out of the eggs, digging their way under the skin of the worm, on whose fatty portions they feed. The caterpillar, however, continues to eat and grow, and lives long enough to make its cocoon, but when once enclosed in it, the parasites which prey upon it have already eaten the fatty portions, and now attack the vital parts of the larva, which they speedily consume, and finally the one that outlives the others makes a cocoon within that of the Polyphemus larva. But it is a remarkable fact that here the maternal instinct of the Ichneumon fly makes a terrible mistake. Several of the Ichneumon larvæ have entered the worm, but only one

of them can find food enough to enable it to arrive at maturity; so probably the strongest one devours its weaker brethren when food becomes scarce, or else they die from hunger.

Description of the larva of Polyphemus. When fully grown this larva measures over three inches in length, and the body is very thick. The head is of a light chestnut brown color; the body of a handsome transparent light yellowish green, with seven oblique lines, of a pale yellowish color, on each side of the body; the segments are each adorned with six tubercles, giving rise to a few hairs, which are tinted sometimes with orange, with a silvery spot on the middle; there are six rows of protuberances, two on the back and two on each side, and the oblique lines run between the two rows of lateral tubercles uniting the lower one to the upper one by a yellowish line. The underside of the body is longitudinally striped with a faint yellowish band; the spiracles are of a pale orange color, and the feet are brown. The posterior part is bordered by a purplish brown angular line similar to the letter V.

Description of the Pupa. The pupa is much of the form and size of a robin's egg; the color is dark chestnut-brown, with a pale greenish spot at the base of the antennæ. The form of the legs, wings and antennæ are distinctly marked, while the posterior part is furnished with a brush of minute hooks.

For a description of the Moth (*Imago*) see the Synopsis of Lepidoptera, by Dr. J. G. Morris*, only observing that there are at least six varieties: the yellow, the ferruginous, the brown, the greenish, the pale cream color, and another variety with the black lunule on the secondaries replaced by a ferruginous spot. The male can be easily

*Published by the Smithsonian Institution, Washington, D. C.

distinguished from the female by its lighter form, and by its smaller abdomen, which is not so highly coloured as that of the female; but the most striking difference is in the antennæ; those of the male are pectinated, broad, and like two feathers adorning the head, while those of the female are narrow and very much smaller.

Description of the Egg. The egg is about one-tenth of an inch in diameter, almost cylindrical, with the two ends convex. The cylindrical surface is brown, with a narrow white spot about one-half the width of the egg; the two convex parts are white. One hundred of them weigh on the day they are laid, eight grains, but an evaporation of the fluid contents of the body takes place, and on the day the young hatch out, the same number weigh only six and two-third grains. One hundred and ten empty shells weigh one grain; about six thousand worms are equivalent in weight to one ounce. I will now proceed to give some instructions as to the rearing of the worm. They will be easily understood, if I have been clear enough in explaining the natural history of the Polyphemus Silk Worm.

Selection and preservation of Cocoons intended for Stock. The cocoons' intended for the propagation of the species for the following year, should be carefully selected. As a general rule the female larva is larger than the male; so the cocoon of a female is also larger than the male cocoon. I estimate a cocoon to be a very good one, and the pupa within healthy, when it is heavy for its size, and resists well the pressure between the fingers, not being deformed by it. About one-half of the number intended for propagation should be selected from among the largest; very probably the majority will be females. The other half should be selected, not among the largest, nor

the smallest, but among the intermediate ones. When properly selected, they should be placed beyond the reach of rats or mice, in boxes, baskets or bags. The boxes should be stored in a cold, dry room, or cellar, where the temperature does not get above forty-five degrees, for if the temperature be higher, they will be liable to hatch before winter. While the temperature should not go above forty-five degrees, it can descend indefinitely without injury to the pupa.

Hatching out of the Moth. Towards the end of May, in the latitude of Boston, the temperature sometimes reaches seventy degrees. I have said above, that a heat of fifty or fifty-five degrees continued for some time, is sufficient to put in activity the causes which transform the pupa to perfect insects. So about the middle of May, the cocoons should be taken out of the cellar and put into the hatching room, as the time approaches when the perfect insect will appear out of its prison. Tables or shelves should be placed in the hatching-room to lay the cocoons upon. They should be spread out, and not piled one upon the other, as the insect in coming out would get to the surface with difficulty. Over the tables or shelves where the cocoons are placed, should be hung pieces of cloth, or net, to which the insect can easily attach its hooks, for the purpose of allowing its wings to develope. The perfect insect rarely comes out before noon, and very few after five o'clock in the afternoon. One should watch the process of exclusion, in order to help the insects when they do not readily find the net, or cloth to cling to, and also to remove those which disturb others whose wings are already expanding. The rays of the sun should not fall directly upon the cocoons, as the heat would cause a rapid evaporation, which would certainly kill the chrysalis.

Towards the evening of the day on which the moths leave their cocoon, an equal number of both sexes should be placed in the same cage, and after pairing, the females should be kept until they die, which will occur in four or five days after their union. The eggs which are stuck to the cage with gum, should be scraped off with a wooden, or whalebone knife, and then spread in a large pasteboard box to dry thoroughly. A ticket, with the date stating when the eggs have been laid, should be put upon the box, so as to indicate the day the worm will probably hatch.

The length of the period of incubation depends entirely on the temperature, but in June, the incubation generally lasts twelve or thirteen days, while in August the period is two days shorter. Eight or ten days after the eggs have been laid, they should be placed in the hatching box, which should be made of tin, and about three inches long, two inches broad, and one and a half inches deep. In the middle, a narrow longitudinal band of tin should be soldered, and bent so as to form a hook by which the box may be hung to some twig or branch. The box should be painted, and before it is dry sand should be sprinkled over it, so as to make a rough surface upon which the worm can crawl with ease.

The larvæ hatch out from five to ten o'clock in the morning, and the attendant should be ready at that time, to place the box upon a branch which has its extremity in the water. A thousand of the little worms can feed upon a branch of moderate size for four or five days, and when it is well covered with them the box may be removed to another branch. The larvæ feed equally well upon the different species of oaks, maples, willows, poplars, elms, hazels, birches, blueberry and other plants, without affecting the quality of the silk.—*Concl. in May No.*

THE LAND SNAILS OF NEW ENGLAND.

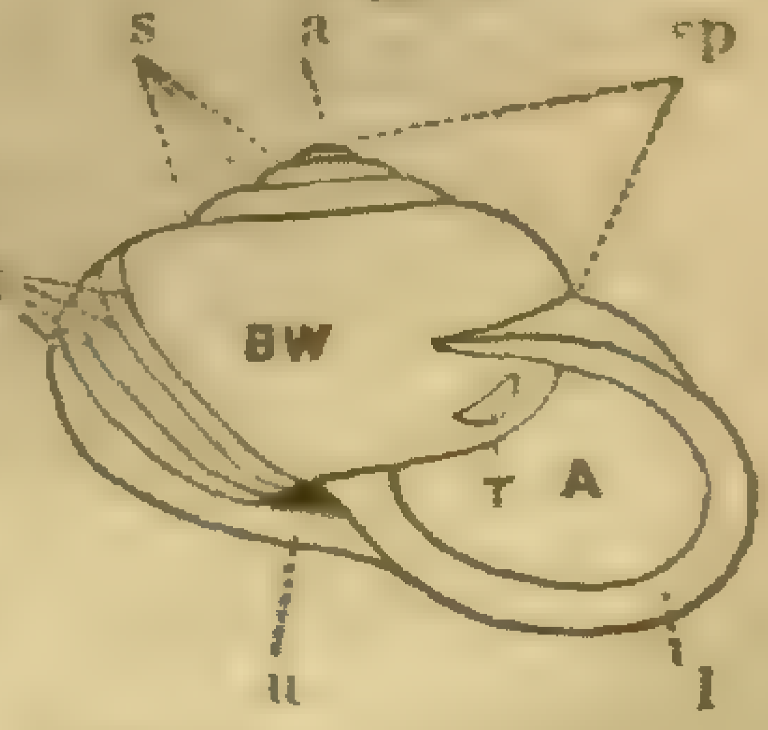
BY EDWARD S. MORSE.

(Continued from page 16.)

We commence the specific description of the Land Snails of New England with a group of the larger forms, of which *Helix albolabris* offers a fair example. It would be more natural to present first a chapter on the classification of the animals to be considered, but we think it better that our readers should first become acquainted with the forms to be classified, that they may the better understand and appreciate the principles upon which the species are grouped into genera and families. In fact, more or less familiarity must be acquired on the general and special history of any group of animals before one can clearly comprehend its classification.

It would be proper that the slugs, or those snails without external shells, should first engage our attention; owing however to the want of sufficient material for accurate figures, we prefer waiting till the spring opens, and an opportunity is afforded to examine fresh specimens, before presenting a chapter on this group. In order that the descriptions of the following species may be understood, we present an explanation of the various terms used in describing shells (see fig. 1). The explanation of the soft parts of the animal was given in the first number.

Fig. 1.



Spire, sp., includes the twists, or whorls of the shell, excepting the last or outside whorl. which is called the *body whorl*, BW. The spire is said to be *elevated*, when the apex and whorls rise above the body whorl, and *depressed* when the whorls do not rise above each other.

Apex, a, is the beginning of the spire, or the part first formed.

Base, is that region of the shell opposite the apex. A shell rests on its base, when the apex is uppermost.

Suture, s, is the seam, or line of division between the whorls.

Umbilicus, u, is a cavity left in the central axis of the shell, around which the whorls revolve. The umbilicus is seen from the base of the shell. The umbilicus is said to be *open* when a distinct perforation appears in the base of the shell; *closed*, when a portion of the lip extends over it, (as in the adult condition of the shells of many species), and *absent*, when the whorls revolve so closely as to leave no central space.

Lip, l, is the border of the aperture. When the edge of the aperture is sharp, the lip is said to be simple. When produced into a flange, it is called a reflected lip.

The *columella* is that portion of the aperture nearest the centre of the shell.

Striæ, st, or lines of growth, are minute lines, running parallel with the border of the aperture, and indicate the successive enlargements of the shell.

Nearly all shells have an outer coating of animal matter, called the epidermis. After the death of the animal this coating soon loses its color, and wears away, leaving the shell faded and bleached.

Helix albolabris *Say*. The general description of this species given in our first number need not be repeated here. Described first by Thomas Say, one of the earliest naturalists of America, it has always been a standard species, quickly recognized by its beautiful russet-colored shell, and the broad white lip bordering the aperture. The animal is variable in color, though generally light-

brown, or greyish. The granulated markings on the body are very distinct. The shell is uniformly light yellowish or russet brown, having from five to six whorls. The aperture is bordered by a broad white lip in adult specimens; the lower portion of the lip extending over the umbilicus. Fig. 2 represents the shell before it has attained its complete growth; the umbilicus is open, and the lip is sharp. The presence of a reflected lip, in those species which have it, always indicates maturity.

Fig. 2.

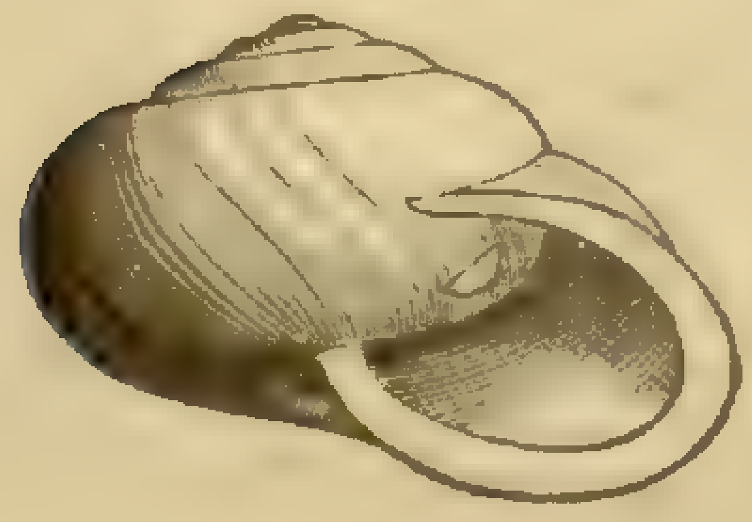
The ordinary diameter of the shell is one inch, though it sometimes attains a larger size.

This species occurs throughout the United States, with the exception of the Pacific coast and the extreme Southern States. They are found in well wooded districts of oak, maple and beech, and oftentimes occur in great numbers on islands. They can be easily kept in confinement, and the shells of those raised in this manner are much more symmetrical and delicate, than those found wild. In order to raise them, it is only necessary to procure a wooden box, or better, a deep earthen bowl, and after filling to the depth of two inches with damp earth from the woods, place a few bits of bark for the snails to lurk under. It is well to imitate as nearly as possible the condition of their native haunts. As the earth becomes dry, moisten with a sprinkling of water, bathing the snails at the same time. They may be fed on flour or meal mixed with water, and occasionally a tender leaf of cabbage or lettuce, of which they are very fond. The young can be easily raised from the egg by observing the above conditions. The eggs, from thirty to fifty in number, are laid in early spring, and hatch in the space of three or four weeks. The snail when first hatched from the egg,

is quite unlike its parent. They attain their complete growth, in from two to three years.

HELIX THYROIDES *Say*. (Fig. 3). The shell of this species resembles very much that of Helix albolabris, but differs in being smaller, slightly more globose, and in having its umbilicus only partly covered. The chief point of difference lies in the prominent tooth-like process on the inner lip. The shell is yellowish horn color; whorls five, finely striated with lines of growth; aperture bordered by a broad white lip; inner lip furnished with a white tooth; umbilicus only partly closed; diameter three-fourths of an inch. Dr. Gould says that, though by no means common, this shell occurs in nearly all parts of Massachusetts. It must be considered a rare shell in New England, though it is a very common species in New York, the Western and some of the Southern States.

Fig. 3.



HELIX SAYII *Binney*. (Figs. 4, 5). This species was named by Dr. Amos Binney, in honor of Thomas Say. The shell is depressed and thin; color shining russet; whorls five, or six; aperture rounded, bordered by a narrow white lip, with a slight projecting tooth near the umbilicus. There is also a prominent white tooth on the inner lip; umbilicus open, allowing all the volutions to be seen; diameter nearly one inch. The animal is light reddish brown, with the tentacles darker. This species, though generally distributed throughout the northern portion of the United States, is by no means common in New England. It has been found in Vermont, New Hampshire,

Figs. 4. 5.

and several places in Maine. It seems to prefer mountain slopes and hill sides. We have picked up the empty shell in numbers, on hill sides that had recently been burnt over, and the collector will often find clearings of this nature, that is where a light hardwood growth has been recently burnt, a good collecting ground for the larger Helices, as the leaves under which they hide become burnt, and the snails are thus exposed, oftentimes uninjured. We extract the following from Binney's Monograph of the Land Snails of the United States, p. 181: "On the third day of July, 1836, I discovered an individual of this species in the act of laying its eggs, in a damp place under a log. I transferred them, with the animal, to a tin box filled with wet moss. The eggs were not much more than half as large as those of *H. albolabris* Say; they were white, adhering together very slightly, flaccid, and apparently not entirely filled with fluid. During the succeeding night the number had increased to about fifty, and in a few hours they became full and distended. As the Snail now began to devour the eggs, I was obliged to remove it. On the twenty-ninth of July, all the eggs were hatched: the young snails had one whorl and a half; the umbilicus was open; the head and tentacles were bluish-black, and the other parts whitish and semi-transparent. They immediately began to feed, and made their first repast of the pellicles of the eggs from which they had just emerged. They grew rapidly, and before the middle of October, when they went into winter quarters, they had increased their bulk four or five times, beyond their original measurement."

Figs. 6, 7.

HELIX DENTIFERA *Binney*. (Figs. 6, 7). Shell with spire flattened, convex below,

whorls five, with delicate oblique striæ; the aperture is flattened towards the plane of the base. The lip is broad and white, inner lip having a prominent tooth; diameter three-fourths of an inch. The animal is grayish on the sides, with the back darker. This species may justly be considered rare, as wherever it occurs, it is generally found sparingly. Dr. Binney found it on the eastern slopes of the Green Mountains. They were at one time numerous in the town of Stratford, Vermont. Four specimens only have been found in Maine, and these were discovered either on the slopes or summits of mountains. It has never been collected in Massachusetts to our knowledge. It occurs in Ohio, New York and Pennsylvania.

It will be hardly necessary for me to state, that the descriptions already given, and those which are to follow, are mainly intended for those who are forming, or wish to form collections in this pleasing branch of Natural History. To such we feel that no apology is needed for the necessary dryness of specific descriptions, and we know that the figures will be acceptable, as the works in which these species are illustrated are rare and expensive, and many of them have not heretofore been given with any approach to accuracy. We hope that no little interest may be excited in those not directly interested in the subject, as illustrating a group of animals but little known to general readers, and affording them some conception of what may be found under the dead leaves, and rotten bark, crushed beneath the feet while rambling in the woods and fields.—*To be continued.*

REVIEWS.

Preliminary Report of the Geological Survey of Kansas. *By G. C. Swallow, State Geologist.* Lawrence (Kansas), 1866. 8vo.

Besides the General Report by Professor Swallow, this preliminary summary of the results of the Survey of Eastern and Central Kansas, contains special reports upon the economical Geology of ten counties, by Maj. F. Hawn, with Reports upon the Climatology of the State, by Dr. Tiffin Sinks, and upon the "Sanitary Relations of the State," by Dr. C. A. Logan.

If the survey had merely established the presence of extensive deposits of Gypsum, Salt, or Coal, it would have thrice repaid its expense to the State. Incalculable wealth may result from a proper use of these discoveries, and the attractions they offer to the capital and labor of the east are very great. The soils of the numerous valleys, and the centre of the State overlying the bands of Triassic and Permian beds, with their "gypsum marls," are described as extremely rich. Even the Coal Measures, here unusually productive, are covered by the bluff formation which makes "the very best soils of the State." The purely scientific interest of the Report we have no space to mention; it is almost wholly devoted to Economical Geology, and in this respect partakes of the general want of completeness manifested in many of our State Reports. This is in no way attributable to their scientific authors, but to the very limited pecuniary aid given them by our legislators. This must necessarily render many of our State reports superficial, and greatly inferior in point of information and economical value to what they might be, were the work of the American Geologist properly supported, both by popular sympathy and proper pecuniary encouragement. With a few honorable exceptions, the State appropriations for Geological surveys, have barely enabled the Geologist to make even the most superficial reconnoissance. It is to be hoped, now that several States are again appropriating funds for Geological, Zoölogical and Botanical Surveys, the means afforded may be ample. The United States Coast Survey has surpassed all similar undertakings in Europe. Why may not the Geological explorations and the construction of Geological maps be carried on with the same energy and equal success, both in a scientific and pecuniary point of view?

Annual Report of the Board of Regents of the Smithsonian Institution for 1865. *Washington*, 1866. 8vo.

There are but few naturalists, especially those residing away from the scientific centres of our country, who have not been aided and en-

couraged in their studies, either by the private correspondence or published works of the Smithsonian Institution. How many young naturalists, and we speak from personal experience, scattered over the country, away from libraries and the stimulus of scientific intercourse, owe to this Institution, founded by the bequest of James Smithson, of England, "for the increase and diffusion of knowledge among men," a great part of their success in investigating natural phenomena!

No institution known to us, in any land, has by such a wise and economical management of its funds, done so much for the advancement of all departments of science. This has been accomplished by the wide and generous distribution of its numerous publications, the use of its large and unique library of scientific periodicals, its duplicates from the Museum of Natural History, and its loan, necessarily guarded, of meteorological instruments, together with its ready aid to those conducting original investigations, and by its general sympathy with the highest scientific culture.

The present volume, printed and distributed as a Congressional document, contains beside the annual statement of the accounts and doings of the Institution, articles of general interest. Among such are the eulogies on General Joseph G. Totten, the conchologist and eminent military engineer, and on Ducrotay de Blainville, the student, unsuccessful rival, and finally the successor of Cuvier in the Jardin des Plantes. There is also an account of the Aurora Borealis or Polar Light, by Professor Elias Loomis; an article on the Senses, translated from the German periodical *Aus der Natur;* lectures on Electro-Physiology, by Professor Carl Matteuci, of Turin, and a very full account by Professor E. Desor, of the "Palafittes, or Lacustrian Constructions on the Lake of Neuchatel," an article of great interest at present owing to the discussions on the antiquity of Man. Throughout the text are distributed numerous cuts illustrating the implements of the age of Stone, of Bronze and of Iron. The report of this able and cautious investigator brings out clearly the fact "that it was the same people who inhabited our soil [Switzerland] during the ages of Stone, and of Bronze, and up to the time of the invasion by the Helvetians."

AMERICAN JOURNAL OF CONCHOLOGY. *Edited by G. W. Tryon, jr.*, Philadelphia. Published quarterly at $10 per year.

The second volume of this Journal, illustrated by twenty-seven colored and plain plates, is completed. It contains many valuable articles by the leading Conchologists of this country, and will be found useful to all studying the Mollusca.

NATURAL HISTORY MISCELLANY.

BOTANY.

THE TERTIARY FLORA OF BROGNON.—Mr. Saporta communicated recently to the Geological Society of France a paper on the flora of a small tertiary basin, at Brognon, north-east of Dijon, in the department de la Cote d'Or, the following abstract of which is from *L'Institut* of July 25:—"The vegetable remains are referable to 13 species of 12 genera, which are *Flabellaria*, *Quercus* (2), *Migrica*, *Ficus*, *Cinnamomum*, *Andromeda*, *Acer*, *Ilex*, *Zizyphus*, *Xanthoxylon*, *Cercis*, *Pecopteris*. The last genus is allied to two ferns, living in the Brazils and at the Cape; the two oakes have their analogues in Louisiana and Guatemala; the fig has its in Eastern India and in Java, *Cercis* and *Cinnamomum* ally this flora to that of Japan; the jujube to that of Timor; *Andromeda* to that of the Isle Maurice. The maple and the holly still live in the Mediterranean region. Floras of a like character are found preserved at Armissan, Manosque, Monod, Œningen, in the 'gypses d'Aix,' and in the Swiss 'Molasse.'"

The author concludes as follows:

1st. That during the period when the flora of Brognon flourished, there was in this locality a fresh water lake, very rich in calcareous sediments by the agency of which the remains of plants living on the margins of the lake have been preserved.

2nd. That the age of the lake may be determined by comparison with analogous deposits; it should probably be placed in the Lower Miocene.

3rd. That this flora consists of a mixture of tropical and temperate forms, and such that characterize the plateaus of Mexico and Central America; and that the temperature of Europe, during the Miocene epoch, was similar to these regions.—*R. Tate, Hardwicke's Scientific Gossip, Oct.* 1, 1866.

DRYING FLOWERS BY HEAT.—Twenty years ago, when botany was my hobby, I adopted a plan for drying my specimens, which was both rapid and very effectual in preserving colours. I borrowed a tin dripping pan from the cook, which was just the size of my sheets of blotting-paper. In this I laid the produce of the day's excursion between sheets of blotting-paper in the usual way, and when the pile was complete I covered it over with a layer of common scouring sand half an inch thick, so that the tin dish appeared to be simply full of sand. I then placed it on the kitchen fender, or on the hob, or in the oven if it were not too hot, and in three or four hours the whole batch of specimens was perfectly dried. It required a little care to take them out at the right moment, when they were baked just enough, and not too much; but this care being given, the success of the plan was perfect. Many specimens still in my herbarium bear witness to the superiority of such rapid drying over the old method."—*F. T. M. Loborough.*

Another Method.—"I have adopted the plan of drying flowers by heat for some years, on the recommendation of a friend. With some plants

it acts very well, but not with others. Much depends on the mode of doing it. It should be done *gradually*, and with an iron *not too hot*. My friend told me that he had taken nearly two hours in thus drying a plant, but he found himself well rewarded. I have *Orchis fusca* now that I ironed out in 1863, and it has lost very little of its colour. *Ophrys muscifera* looks well ironed; so do grasses."—*Henry Utlyett. Hardwicke's Scientific Gossip, Aug.* 1, 1866.

ZOÖLOGY.

FLIGHTS OF BUTTERFLIES.—In Europe, we have had notices of remarkable flights of swarms of butterflies; but Sir Emerson Tennent, in his work on the Natural History of Ceylon, has related similar instances of "flights of these delicate creatures, generally of a white or pale yellow hue, apparently miles in breadth, and of such prodigious extension as to occupy hours and even days, uninterruptedly in their passage":—

"The butterflies I have seen in these wonderful migrations, in Ceylon, were mostly *Callidryas hilariæ*, *C. Alcmeone* and *C. Pyranthe*, with straggling individuals of the genus *Euptœa*, *E. Coras* and *E. Prothoe*. Their passage took place in April or May, generally in a north-easterly direction. A friend of mine travelling from Kandy to Kornegalle, drove for nine miles through a cloud of white butterflies, which were passing across the road by which he went." p. 403.

GEOLOGY.

THE FIRST APPEARANCE OF MAN ON OUR PLANET.—"Although perhaps more interesting in an ethnological than in a geological point of view, we cannot altogether exclude from our notice the phenomena attending the first appearance of Man on our planet. The discoveries of the last few years have satisfactorily shown that the opinions formerly entertained of a great break existing between the period when the now extinct races of Mammalia dwelt in our land. and the first creation of man, are no longer tenable. Here also we have been obliged to give up the theory of great breaks between successive formations. As we find a gradual passage from one geological formation to another evidenced by the *gradual* dying out of the pre-existing forms of animal life, and the *gradual* introduction of newer, and generally higher, forms (although we do not yet understand the law of such progressive changes), so, when we come to the most recent, or Quaternary, periods in geological chronology, we find evidence of Man's existence on the earth before the final disappearance of those varied forms of mammalian life which have hitherto been generally looked upon as belonging to the final period of the geological cycle. Thus Man of the present day is connected by an almost unbroken series of links with

the recently discovered Foraminifera of the Laurentian gneiss."—*Anniversary Address of the President (Sir R. I. Murchison) of the Geological Society of London.* 1866.

THE EOZOÖN IN AUSTRIA.—"Prof. Hochstetter, after long and laborious search, has succeeded in finding, in the crystalline limestone of Krummau, in South-western Bohemia, agglomerations of calcareous spar and serpentine, which have been declared by Dr. Carpenter, to whom specimens had been sent for examination, to be undoubted remains of *Eozoön*. Professor Hochstetter thinks the lenticular nodules partly composed of calcareous spar and serpentine, so abundant in the vicinity of the graphitic beds of Schwarzenbach and Mugerau, to be possibly of organic origin. Prof. Gümbel has lately found the *Eozoön* in the crystalline limestones of Bavaria."—*Quarterly Journal of the Geological Society.* London. 1866.

The *Eozoön* is the earliest form of animal life known; it belongs to the lowest type of animals, the *Protozoa*, and has only been found in the oldest rocks on the globe: i. e., the Laurentian System, consisting mostly of gneiss, limestone and syenitic rocks. It was first discovered in Grenville, Canada, by the Canadian Geological Survey, and afterwards in Connemara, Ireland.

CORRESPONDENCE.

WASPS AS MARRIAGE-PRIESTS TO PLANTS.—"Among these Wasps (though technically not a wasp at all), is a fine, handsome insect which has greatly piqued my curiosity, because I have not been able to locate it, even as to its family. Can you inform me what it is? It is near the Sphegidæ, or the Scoliidæ of Westwood, but differs materially, I think, from both. I did not preserve any perfect specimen of the insect. Its striking peculiarities, in addition to its handsome appearance on the wing, or when settling on the flowers of the Asclepias, with its antennæ busily employed gently playing upon the outside of the flower, while the labium is as busy inside—are the elongated labium and the very singular appendages to the tarsus, a drawing of one of which, highly magnified, I enclose. I think from the appearance of the spines upon the tarsus, that nearly all of them have borne these appendages, which have been broken off of such as are now without them. The terminal lobe of the appendage is light green, while the enclosed granules (or cells) are

Pollen attached to the spines of a wasp's leg.

darker. Westwood (Classification of Insects, vol. ii., fig. 82, p. 197) figures from Savigny* a probably similar appendage to the maxillary palpus of one of the Larridæ, and surmises that it was the result of disease.

From the general appearance of these appendages, their existence on all of the tarsi, and on all of the insects of this species hitherto examined by me, I do not think they result from disease, but are characteristic of the insect."—*T. Chambers, Covington, Ky.*

The wasp is evidently allied to *Tachytes*, one of the Larridæ. We trust our correspondent will, during the coming season, secure specimens for accurate identification, and renew his observations on a point so interesting alike to the Entomologist and Botanist.

We sent Mr. Chamber's drawings to Mr. Horace Mann, of Cambridge, without stating that the insect had been seen on the Asclepias, who thus writes:

"I received your note, with the very interesting sketches in it, last evening. The masses which have attached themselves to the wasp's leg, are, as you suppose, pollen, that of some species of *Asclepias*, the Milkweed or Silkweed. By referring to Gray's Manual of Botany you will find the structure of the flowers described on p. 351, and by referring to his Systematic and Structural Botany you will see it figured on p. 459. I showed the drawings to Dr. Gray, who was very much delighted with them, and begs, as I do, that you will have a wood-cut made of the small one, to show what a quantity the wasp managed to pick up in his perigrinations. A cut reduced to half the size of the drawing would answer every purpose, and be very interesting and instructive to Botanists."

In our specimen of *Tachytes*, there are four pollen masses attached to the spines on two of the legs. They evidently adhered to the spine by the viscid base of the pollen mass. They agree well with the drawing of Mr. Chambers, of which we give a wood-cut reduced one-half.

In regard to works on the Hymenoptera, or bees, wasps, etc., of this country, you will find many species described in H. de Saussure's great work on the Vespidæ (Monographie des Guepes Sociales, Paris et Genève, 1853-58, 3 vols., 8vo). You will also find the Catalogue of Hymenoptera in the British Museum, by Frederic Smith, London, 12mo., vols. 1-4, to be an indispensible work. Many are also described in the new edition of Say's "American Entomology" and his other works edited by Dr. LeConte and published by Ballière Brothers, New York. Other papers describing many of our most common forms, are scattered through the Proceedings of the Entomological

*On comparing Savigny's original plate, the rounded masses are evidently pollen, which led us to suppose those on this insect to be of the same nature. Afterwards we found precisely similar masses of Asclepias pollen on *Tachytes aurulentus* Fabr., in the Museum of the Essex Institute.—EDS.

Society of Philadelphia, the Proceedings of the Essex Institute, the Boston Journal of Natural History, and the Annals of the Lyceum of Natural History of New York.—Eds.

NATURAL HISTORY CALENDAR.

New England Reptiles in April.—The month of gladsome sounds has come! The little "pee-weep-ing" Tree Toads, with their high-pitched whistling notes, will soon convince you of the fact, if you are so fortunate as to live without the city walls; for on the first balmy evening, when Nature seems to open her heart and voice, you will be strongly impelled to stroll beyond the limits of your recent walks, and be you ever so stoical, you cannot close your ear to the joyous sounds that will rise from every swamp, ditch, and pool.

Yes! the little Tree Toads have left their winter homes, and come forth to announce in joyful chorus that Spring is here; that the cold and dreary days are over, and to bid us welcome the bright and happy ones to come.

Let us accept the invitation and visit the spot where the little revellers of night invite us so cordially. With what joy do they seemingly anticipate our coming—what music to the sympathetic ear. Hark! ten thousand little throats are sounding their welcome. We are near them. Hush! all is still.—One timid, cautious note, *peep*, strikes our ears, and, regardless of prospective colds, we seat ourselves on the damp bank resolved to see the little musician; assuring the little pipers by our quiet and attentive attitude that we will listen to their song of joy and greeting. *Peep, peep*, comes from a spot not far away. Another *pee-e-p*, still nearer; then *pee-weep, pe-weep, pe-weep, pe-weep, pe-weep*, and the chorus is at its height. The thousand invisible musicians are satisfied that we love their sounds. Move not or all will be hushed; for these little minstrels are jealous of their right to a quiet audience, and to enjoy their music that right must be respected. Observe that miniature wave circling from that spear of grass quite near the bank; look closely there, and you will see a little pointed head rise cautiously above the water, and then,—*pee-weep*. Yes! there is one of the little fellows! and we return home gladdened by their music, and contented that we have discovered the character of these happy little choristers of spring, and have found them to be our little summer friends of the woods, instead of Turtles, as we have from our youth been told.

During the first week in this month, the Little Tree Toads (*Hyla*

Pickeringii Le Conte) will be out in abundance, and about the 10th or the 15th their eggs may be found attached singly to the floating vegetation; never in strings or masses, as is the case with all our other toads and frogs. In about twelve days the young are hatched, and are much further advanced in the tadpole state, than in our other species of frogs and toads, which do not have distinct tails, well marked heads, and the power of free locomotion for several days after they are hatched, and therefore remain during that period in the gelatinous mass surrounding the eggs; but the eggs of the Little Tree Toad not being provided with this jelly-like substance, the young are forced to swim about in search of food, as soon as they leave them, and are, therefore, more perfectly adapted to their period of "fish-life" from the first.

The peculiar half-grunts, half-croaks of the Wood Frogs (*Rana sylvatica* Le Conte) are first heard, generally, about the middle of the month in ponds or even temporary pools of water. In a few days their eggs are laid in masses about three inches in diameter, attached to spears of grass, and they leave the water for their summer abode in the damp and shady woods. The eggs are hatched in about six days, and the tadpoles, rapidly developing, attain the form of adults by the time the temporary pools are dry.

The Common Toads (*Bufo Americanus* Le Conte) usually appear from the 15th to the 20th of April, when their peculiar low trilling notes are heard in every direction for a month or two afterwards. Their eggs are laid in long double strings, from about the 20th of April to the middle of May, and often even as late as June, owing, probably, to the great distance many of the Toads have to travel in order to reach the water. The tadpoles are commonly hatched ten days after the eggs are laid.

The Spade-footed Toads (*Scaphiopus Holbrookii* Baird) are more uncertain in their appearance, being governed entirely by the dampness or dryness of the season, and are only found in isolated localities. Often appearing by the middle of this month, they may not, on a following year, come forth until a long summer's rain has made temporary ponds. Their appearance may be delayed even to the middle or last of July, and frequently several years will pass without their being noticed at all. When they do appear, it is always suddenly and in immense numbers. They remain but a day or two in the water, disappearing as mysteriously as they came; leaving behind them thousands of eggs, in bunches of from one to three inches in diameter. Generally these bunches are attached to spears of grass, though they were once observed floating freely in a temporary pond. The tadpoles come forth in about six days after the eggs are laid, and their growth

is very rapid, not more than two or three weeks elapsing before the young toads leave the water. The peculiar, harsh croaking of this singular toad must be heard to be appreciated, and can then never be confounded with that of any other species. The only sound we can liken it to is that of a heavily loaded, creaking wagon rolling over hard and uneven ground.

About the last of the month we have found singular bands of eggs, several inches in length, each band consisting of three irregular rows of eggs, which we have taken to be those of the large Tree Toad (*Hyla versicolor* Le Conte), whose low monotonous rolling note is heard throughout the summer, but we have never been able to confirm the supposition. The eggs collected did not solve the question, as all the tadpoles which were hatched from them in the course of five days, died before they exhibited the characters of any toad or frog with which we were acquainted; though in the tadpole state they were very much like the tadpoles of *Hyla Pickeringii.*

The other species of Frogs found in Massachusetts do not lay their eggs before May or June, though they all appear from the first to the middle of the month, and their various notes and peculiar croaks add much to the lively chorus of Spring. They are the Spotted Frog, Marsh Frog, or Pickerel Frog (*Rana palustris* Le Conte); the second species of Spotted Frog, Marsh Frog, or Field Frog (*Rana halecina* Kalm); the Green Frog (*Rana clamitans* Daudin); and the Bull Frog (*Rana Catesbyana* Shaw).

The several species of Salamanders (improperly called "Lizards") are also to be found either in water, or under stones and logs, in wet, or damp and shady localities, each according to its peculiar habits, but they do not lay their eggs until later in the season. The Turtles and Snakes also creep from their winter retreats, and are to be seen on bright sunny days endeavoring to warm their cold bodies after their long winter sleep.—F. W. P.

Ornithological Calendar for April. 1st to 10th.—The Pine and Yellow Redpoll Warblers, Ruby-crowned Kinglet, the Woodcock, Killdeer Plover; the Great Blue and Night Herons, the Bitterns, the Kingfisher, the Fish Hawk, Sharp-shinned, Cooper's and Sparrow Hawks commonly begin to make their appearance. Snow Birds, Song, Fox-colored and Tree Sparrows are more abundant than at any other period of the year. The last of the winter visitors are retiring. Geese and Ducks are passing in flocks to the northward.

10th to 20th.—During this time appear the Hermit Thrush (*Turdus Pallasi* Cab.), White-bellied Swallow, and the Golden-winged Woodpecker or Wakeup. Chipping, Field and Savanna Sparrows arrive; also, the Willet; the Tell-tales; the Least, Semipalmated, Solitary and

Spotted Sandpipers, Wilson's or English Snipe, Golden and Field Plovers. The Fox-colored and Tree Sparrows, Snow Birds, Pine Finches and Shore Larks mostly disappear, passing northwards. Robins, Song Sparrows, Carolina Doves, Meadow Larks, the Crow, and the smaller Hawks pair.

20th to 25th.—The Wood Thrush (*Turdus mustelinus* Gm.), the Purple Martin, Brown or Tit Lark, White-throated and White-crowned Sparrows, Virginia and Common Rails, the Marsh, Sooty and Wilson's Terns, the Green Heron and the Little Bittern arrive; some of them scarcely halting in their passage northward.

25th to 30th.—The Chewink or Towhee Bunting, Barn Swallow, Chimney Swift, Cat Bird, Black and White Creeper, Yellow-bellied Woodpecker, Least Flycatcher, Warbling and Solitary Vireos and the Whip-poor-will begin to arrive; not usually becoming common until a week or ten days later. Blue Birds, Robins, Grass Finches, Field and Song Sparrows, and Kingfishers are now nesting, or have occasionally even commenced incubation.—J. A. A., *Springfield, Mass.*

THE INSECTS OF EARLY SPRING.—In April the Gardener should scrape and wash thoroughly all his fruit trees, so as to rub off the eggs of the Bark Lice which hatch out early in May. Many injurious caterpillars and insects of all kinds winter under loose pieces of bark, or under matting and straw at the base of the trees. Search should also be made for the eggs of the Canker Worm and the American Tent Caterpillar, which last are laid in bunches half an inch long on the terminal shoots of many of our fruit trees. A little labor spent in this way will save many dollars' worth of fruit. The "castings" of the Apple Tree Borer (*Saperda bivittata*) should be looked for at the base of the tree, and its ravages be promptly arrested. Its presence can also be detected, it is said, by the dark appearance of the bark, where the grub is at work: cut in and pull out the young grub. It is the best time of the year to catch and kill this pest. Cylindrical bark borers, which are little round black weevil-like Beetles, often causing "fire-blight" in pears, etc., are now flying about fruit trees to lay their eggs; and many other weevils and boring-beetles, especially the Pea Weevil (*Bruchus pisi*), the Pine Weevil (*Pissodes strobi*), and *Hylobius pales* and *Hylurgus terebrans*, also infesting the pine, now abound, and the collector can obtain many species not met with at other times.

The housewife must now guard against the intrusion of Clothes' moths (*Tinea*), while many other species of minute moths (*Tineids*), and of Leaf-rollers (*Tortricidæ*), will be flying about orchards and gardens just as the buds are beginning to unfold; especially the Coddling Moth (*Carpocapsa pomonella*). On warm days myriads of these and other insects may be seen filling the air; it is the busiest time of their

lives, as all are on errands of love to their kind, but of mischief to the Agriculturist.

When the May Flower—"O commendable flowre and most in minde"—blooms, and the willows hang out their golden catkins, we shall hear the hum of the wild bee, as it

"Murmurs the blossomed boughs around,
That clothe the garden's southern bound,"

and the insect hunter will reap a rich harvest of rarities. Seek now on the abdomen of various wild Bees, such as Andrena, for that most eccentric of all our insects, the Stylops Childreni.* The curious larvæ of the Oil Beetle, *Meloe*, may be found abundantly on the bodies of various species of Bombus, Andrena and Halictus, with their heads plunged in between the segments of the bee's body.

The beautiful moth, *Adela*, with its immensely long antennæ, may be seen, with other smaller moths, feeding on the blossoms of the willow. The Ants wake from their winter's sleep and throw up their hillocks, and the "thriving pismire" issues from his vaulted galleries constructed in some decaying log or stump, while the angle worms emulate their six footed neighbors. During the mild days of March, ere the snow has melted away—

"The dandy Butterfly
All exquisitely drest,"

will visit our gardens. Such are various kinds of Vanessa, Grapta and Melitæa. The beautiful *Brephos infans* flies before the snow disappears.

"The Gnat, old back-bent fellow,
In frugal frieze coat drest"

will celebrate the coming of Spring, with his choral dance. Such is *Trichocera hyemalis*, which may be seen in multitudes towards twilight on mild evenings. Many Flies are now on the wing, such as Tachina and its allies, the four spotted Musquito, *Anopheles quadrimaculatus*, and the delicate species of Chironomus, whose males have such beautifully feathered antennæ, assemble in swarms. Now is the time for the collector to turn up stones and sticks by the river's side and in grassy damp pastures, for Ground Beetles (*Carabidæ*), and to frequent sunny paths for the gay Cicindela and the Bombylius Fly, or fish in brooks and pools for water Beetles and various larvæ of Neuroptera and Diptera; while many Flies and Beetles are attracted to freshly cut maples or birches running with sap; indeed many insects, rarely found elsewhere, assemble in quantities about the stumps of these trees, from which the sap oozes in March and April.—A. S. P.

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*See an account of this curious insect in the Proceedings of the Essex Institute, vol. 4, p. 130, 1865.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Boston Society of Natural History. *Jan.* 16, 1867.—Mr. W. Winwood Reade, referring to his own remarks at a previous meeting, stated that as the Cynocephalus must have been known to the Carthagenians in their own country, he was inclined to withdraw his opinion that this was the animal seen by Hanno in his celebrated voyage, and whose skins were hung up in the temple on the arrival home. He still did not believe it possible that it could have been the Chimpanzee, and considered the question still unsettled. He gave an interesting account of the manner in which the race of Fans on the West Coast of Africa entrap the Elephant, suggesting it as possible that the Elephant of the Equator differed from that of Southern Africa, in certain respects, being found only in small companies of from two or three to twenty, instead of large herds, while it is by no means as wary as the more Southern form. Having discovered the proximity of Elephants in the forest, the Fans build an enclosure in the neighborhood, by surrounding a somewhat open space of a few acres with a strong, though low fence, leaving a small opening on one side. Into this they entice the Elephants, by scattering food of which they are particularly fond, and by supplying them with food and besmearing the fence with some disagreeable compound, retain them within the enclosure, which the Elephants could otherwise without difficulty break down, where the natives kill them at their leisure. This tribe of Fans was pushing down from the interior toward the coast, and would soon supplant the Nepongwes, who were fast dying off, owing to the insalubrity of the climate, and who themselves, according to their traditions, formerly came from the "bush," or interior. The Fans were first made known to white men by the discovery of Mr. Wilson in 1852.

Essex Institute, *Salem*. *Jan.* 21, 1867.—Mr. F. W. Putnam called attention to a donation of several Snakes from Hong Kong, and remarked on the reptilian fauna of China, as compared with that of North America.

Mr. Putnam also called the attention of the Society to some observations recently published by Dr. B. Gilpin, of Halifax, N. S., on the habits of the Salmon, especially during the breeding season.

The members then discussed the origin of the *Black Wart* on the Plum Tree. The disease was regarded as being due to a constitutional decline of the tree, during which the bark loosens and cracks open, when a fungus (*Sphæria morbosa*) locates itself on the diseased part, giving it a swollen and black appearance. The grubs of the Plumb Weevil often live in the wart, but they have no agency in producing it.

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SOME ERRORS REGARDING THE HABITS OF OUR BIRDS.

BY T. M. BREWER, M. D.

THERE are few who have written upon the habits of our birds that have not inadvertently committed errors. There are none of us, certainly no ornithologists, who, with all the care they may have taken to be right, and with all possible desire to be exact, have not had occasion to retrace their steps, and seek to amend their record. There is no name, however celebrated in the annals of science, but has come down to us associated with more or less of inaccurate observations; and the more extensive his researches, the more brilliant his discoveries, the more numerous shall we find the mistakes and errors he shall have placed on record. These considerations suggest great charity and forbearance in dealing with the errors, the wrong conclusions, or the inaccurate generalizations from too few facts, or from facts which different circumstances, at other times, cause to assume a very different aspect.

At the same time, however charitable we may be, however lenient even towards errors and incorrect statements

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that apparently might have been avoided, we should also, all of us; never hesitate to expose and to correct whatever we know to be wrong. We all know but too well, that when a grave error has once been deliberately given as a fact by a distinguished authority, how hard and apparently impossible it is to stop its currency as truth, and to correct the mistaken belief it has caused, and is continually causing.

Take for instance the statement made by one of the earliest explorers of the natural history of our Pacific shores, that the egg of the California Vulture (*Cathartes Californianus*) is *jet black*. However conflicting with all inference by analogy this statement must have ever appeared to every one familiar with Oölogy, it has found its way into nearly every work on American Ornithology published during the present century.

In no department of natural history is extreme accuracy so absolutely indispensable as in that to the study of which the writer has given his chief attention, the nesting and eggs of birds, which, for convenience, is called Oölogy. As the writer, if he lives long enough to publish the completion of his labors in this department, will have to confess himself not an exception to the rule—to which he can find none—and must retrace, amend, and, if he can, efface, it will become him to be especially lenient in his allusions to the mistakes made by the greater lights of American Ornithology.

Among our writers on these subjects, few enjoy or deserve a higher reputation for intelligent observation, great care and general accuracy in his descriptions, than the distinguished pioneer of American Ornithology, Alexander Wilson. The discoverer of many of our rarer birds, he was also a very close observer of their habits, and many of

his descriptions of some of the more common ones are so full and accurate, that they leave us little to add to them. Yet even Wilson, in several noticeable instances, in writing about birds that are far from being uncommon or rare, has given descriptions and accounts which the experience of others, and especially those of the writer, have not been able to verify. We will speak of only a few of these instances.

Let us first take the common American Goldfinch (*Carduelis tristis*), so widely distributed, so familiar to every one, and read what Wilson writes in reference to its nest and eggs: "They build a very neat and delicately formed little nest, which they fasten to the twigs of an apple tree, or to the strong, branching stalks of hemp, covering it on the outside with pieces of lichen, which they find on the trees and fences; these they glue together with their saliva, and afterwards line the inside with the softest downy substances they can procure. The female lays five eggs, of a dull white, thickly marked at the greater end; and they generally raise two broods in a season."

It appears singular to all who are familiar with the nest and eggs of the Goldfinch, which in Massachusetts, so far as the writer has observed, agree in no one thing with the above, how this description could have found a place in the work of so accurate and trustworthy a writer. The explanation is not easy, nor shall we try to suggest one. We will only state, that, without exception, we have ever found the egg unspotted, of a uniform white color, which, when not blown, has a slightly bluish shade. The nest is neat, but "delicate" is far from being an appropriate expression. It is not to be used in reference to the nest of this bird, as we should apply it to the nest of the Hum-

ming Bird, or to that of the Blue-Gray Flycatcher. It is not a "little" nest in view of the relative size of the bird, and we never saw one that was ever covered on the outside with lichen. With us this bird, so far as the writer knows, never builds its nest until as late as the middle of July, and never raises more than a single brood in one season.

To the question: To what bird did the nest described by Wilson as that of the Goldfinch belong? we will in Yankee fashion reply by asking another. Could he by any possibility have had in view the nest and eggs of the *Polioptila cœrulea?* This is what Wilson says in regard to the nest and egg of this last-named bird: "It arrives in Pennsylvania, from the South, about the middle of April, and about the middle of May builds its nest, which it generally fixes among the twigs of a tree, sometimes at the height of ten feet from the ground, sometimes fifty feet high, on the extremities of the top of a high tree in the woods. This nest is formed of very slight and perishable materials, the husks of buds, stems of old leaves, withered blossoms of leaves, down from the stalks of ferns, coated on the outside with grey lichen, and lined with a few horse hairs. Yet in this frail receptacle, which one would think scarcely sufficient to admit the body of the owner, and sustain even its weight, does the female cow-bird venture to deposit her eggs."

It does not become a writer who has never happened to have seen the nest of this bird *in situ*, to be over-confident in correcting the above statement. Yet he will venture to say that several kind friends who live, or who have lived, where these birds are common, have supplied him with many nests and eggs of this bird, and the very

last epithet he would think of applying to any he has seen is the word "*frail.*" On the contrary, if he were asked to name a bird, the nest of which combined beauty, completeness, safety, and (in view of the small size and light weight of the parent) strength, he could think of no bird he would sooner name than the one he is speaking of. Remember that the bird, as Wilson himself tells us, "but for its length of tail would rank next to the Humming Bird in magnitude." Its nest has invariably been found, so far as we know, very large for the size of its builder, with soft but strongly felted walls, a great depth of cavity, so that there is no danger of the eggs ever rolling or being thrown out by the motion of the branches, or of being broken.

Here let us make a suggestion. Some of our birds, like the Humming Birds, the *Parula Americana*, and others, occupy their nests before they are completed, and finish them afterwards. Sometimes the female begins to deposit its eggs before the nest is half finished, and while incubation goes on, its mate busies himself in completing, strengthening, and beautifying the structure. The Gnat-Catcher may, and is quite likely to be a bird that does the same thing, and Wilson may have seen one not finished, while all we have seen may have been completed. Be that as it may, the whole genus of *Polioptilæ*, so far as we know, *P. cærulea*, *P. melanura* and *P. Lembergii*, all have the same style of nest, and all are conspicuous for their elegance and substantial form.

The Indigo Bird (*Spiza cyanea*), Wilson tells us, is "numerous in all the settled parts of the Middle and Eastern States," and yet he says "The nest of this bird is usually built in a low bush, among rank grass, grain, or clover, suspended by two twigs, one passing up each side;

and is composed outwardly of flax, and lined with fine dry grass. I have also known it to build in the hollow of an apple tree. The eggs, generally five, are blue, with a blotch of purple at the great end."

To this we must add the negative evidence, that we have never found this bird breeding as above described, and, so far as we know, the eggs are invariably white, with only a very light tinge of blue, and they never have purple markings at the greater end, nor have they any spots or markings whatever.

One more remarkable case of incorrectness on the part of Wilson, and we pass to consider other writers. Speaking of the nest and eggs of the Black-throated Bunting (*Euspiza Americana*), he says, "They seem to prefer level fields covered with rye grass, timothy, or clover, where they build their nest, fixing it on the ground, and forming it of fine dry grass. The female lays five white eggs, sprinkled with specks and lines of black."

The position of the nest and materials is, in most cases, as stated; but the eggs are not white, and are unspotted. They are of one unvarying shade of green, strongly tending to blue. Occasionally the nests are built more elaborately than others, and on low bushes or tufts of grass a foot or two above the ground.

Mr. Nuttall, of all our writers who have written so much, has, perhaps, the least to correct where he gives his own personal experiences. Of course he has copied or incorporated into his own narrative very many errors that have originated with others, and for which he is only indirectly responsible. He has also failed to detect some very important errors, when the opportunity was presented, and the means spread open before him. We will take only a single instance. One of the most common birds

of Massachusetts, and especially of that part where Mr. Nuttall resided for many years, is the *Empidonax minimus*, the habits of which, its nesting and eggs, he fully describes, but all of which he attributes to an entirely different species which, so far as I am aware, is never found in Massachusetts: I mean the *Empidonax Acadicus*. To be sure Mr. Nuttall was not alone in this. Even after the Bairds had discovered and described the *E. minimus* as a new species, it was several years before the natural sequence was traced out to its legitimate end. It seems to us now remarkable, as we look back upon the past, and consider how familiar a bird the Least Fly-Catcher was to Mr. Nuttall, that he never once seems to have suspected it of being a new and undescribed species. The error made by Wilson in describing the nest and egg of the *E. Acadicus*, may have contributed to delay and to prevent the discovery of the general error and of the confounding of the species. It was not until by a lucky accident, a parent bird of the true *E. Acadicus*, shot on its nest, was sent, with its eggs and nest, to Prof. Baird, that the whole was made clear, and facts in regard to the two species rightly understood. And here the writer may as well make the confession that all the while he had in his own cabinet the eggs of both species, but supposing the one to be the *Acadicus*, by the rule of exclusion he guessed the other to be, possibly, the egg of the *minimus*, and both were wrong of course. The late Dr. Henry Bryant also, one of our most acute and observing ornithologists,* calls attention to what he supposed to be an error of writers in speaking of the *Acadicus*, as being wild and inhabiting the most solitary places, he having found the supposed birds generally quite familiar, and breed-

* Proceedings of the Boston Society of Natural History, vol. vi. p. 430.

ing near his house. He was unaware that the writers he speaks of, were not wrong in what they had said of the *Acadicus*, and that he and they had different species in view, the habits of which were so different as to be noticed by him, yet not such as to lead him to detect their specific distinctions.

Of Mr. Audubon's inaccuracies, I will not here speak at any length, nor am I willing to be suspected of any sympathy with those who have sought, on this account, to detract from the transcendent merits of the great painter and student of nature. While, however, we honor all that was excellent, we may at the same time, without disparagement to his great merits, correct whatever mistakes may have crept into his works, and even be pardoned if we enjoy a quiet laugh over some conclusions, now known to be visionary, but which his exuberant imagination, now and then, led him to put into printed words. We will take only one instance.

In his account of the common Black-Poll Warbler (*Dendroica striata*), we find the following eloquent picture of the delight with which he first discovered the nest of this bird: "One fair morning, while several of us were scrambling through one of the thickets of trees, scarcely waist high, my youngest son chanced to scare from her nest a female of the Black-Poll Warbler. Reader, just fancy how this raised my spirits. I felt as if the enormous expense of our voyage had been refunded. There, said I, we are the first white men who have seen such a nest."

It seems almost too bad to apply the touchstone of sober reality to so charming an evidence as is here given of the whole-hearted manner with which this enthusiastic lover of ornithology devoted himself to his mission,

His warmth and gratification have a touch of true poetry. But when we know that Mr. Audubon's whole party started in the expedition from Eastport, in Maine, where they also spent several days before they commenced their voyage to Labrador, and that one of his party was a near resident to Eastport; and when we further know that all around Eastport, and especially on the islands, the Black-Poll Warbler is one of the most common birds, we must see at once how far a vivid imagination has supplied the material for his conclusions, and that they had but little foundation in reality.

We will not dwell here any further upon the statements occurring in Mr. Audubon's writings, not consistent with the facts, as now known to us, for our limits do not permit, and the instance given above will sufficiently answer as an example of the mistakes into which his over-sanguine temperament occasionally led him. His errors, we are sure, are never intentional; his statements of facts, when he tells us they are his own, we can rely upon: but when he accepts the information of others, or draws inferences from insufficient data, it is then that his accounts must be received with more caution, and that he exposed himself to the unkind and bitter attacks, in which those who do not appreciate his real excellences, or who are too intolerant of what are, after all, only venial faults, spots on the face of a great luminary, have too often indulged.

A few words on our own shortcomings, and we will close these desultory remarks. The Oölogy of North America, Part I., gives several illustrations which subsequent investigations show to have been not so well authenticated as they were supposed to be when published. They are: The egg given as that of the Goshawk (*Astur*

atricapillus), on the authority of a Western naturalist; that given for the egg of the Western Rough-Legged Hawk (*Archibuteo ferrugineus*), on the authority of the late Dr. Heermann; that of the Pigeon Hawk (*Falco columbarius*), the grounds for which supposition were given in full; and that of the Violet-green Swallow (*Hirundo thalassina*), on the authority of the late Dr. Webb.

Subsequent discoveries of well-authenticated eggs of all these birds, quite different from those figured, seem to show that in each instance there is an error in regard to their identity.

The egg figured for that of the Goshawk is, possibly, a very faint specimen of a Red-tailed Hawk's. The Swallow's egg may be that of *Hirundo lunifrons*, and that taken for the Pigeon Hawk's, that of a Cooper's Hawk. The egg given by Dr. Heermann as that of the Western Rough-leg, cannot now be determined. It evidently is not what it was supposed to be.

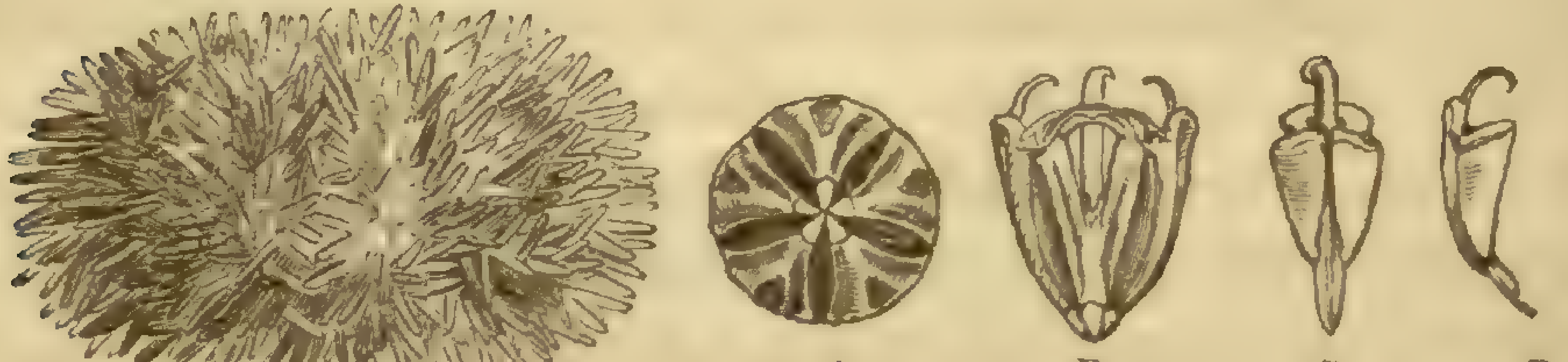
Without seeking to conceal the fact that four of the eggs figured in the Oölogy, appear not to belong to the places in which they are found, nor to wholly absolve the writer from so much of the responsibility as belongs to him, of having been led into errors by the mistakes of others, he may here state that in regard to the egg of the *Falco columbarius*, it was given as such at the time, with the full expression of grave doubts as to its authenticity. All the facts, all the contradictory evidence, were given with all possible care, and to the reader was given all the data in the writer's power, to enable him to form his own judgment. An English traveller, who was so fortunate as to procure specimens of undoubted eggs of this bird, has seen fit, in the pages of the

"London Ibis," to comment, with some impertinence, upon the want of good judgment shown in not accepting Mr. Audubon's testimony as positive, and as outweighing what seemed contradictory to it. It is a sufficient answer to all this, to here add that by not doing as this writer now suggests, supposing the case fully made out in favor of his views, another mistake was avoided. The egg figured and described by Mr. Audubon is, in my judgment, not that of this bird, but of the Sharp-shinned Hawk. My English friend was, therefore, a little fast, and his comments are not based upon quite so sure a foundation as he supposed. Another time, perhaps, he will confine himself to facts within his scope. In assuming that Audubon was *ex necessitate* right, he presumed beyond his ability to establish.

If, in the above pages, I have shown, however imperfectly, to all ornithological readers, how easy it is for the most careful and best intentioned to make mistakes, to be led into errors, to make wrong deductions, and to fail to see and to correct previous wrong conclusions; and if I shall succeed in impressing upon all students in Oölogy especially, the absolute need there is always of the most thorough identification of the bird to which their eggs belong, I shall have done all that I have sought to do. Never keep in your collection, except as a curiosity, an egg or nest which has not been identified. Above all, never guess at its parentage. Never name it without the most unquestionable evidence that you are right. While there are a few eggs that are unmistakable, there are more that you can never be sure of, save by positive knowledge of their parentage.

THE FOOD OF THE COMMON SEA-URCHIN.

BY J. W. DAWSON, LL.D.



A B C D

THOUGH this creature* is so common on the north-eastern coasts of North America, the nature of its food does not seem to be generally known. In dissecting some specimens collected at Tadoussac, Canada, last summer, I found the intestine full of small round pellets, which proved to be made up of the minute confervoid sea-weeds that grow on submerged rocks, mixed with many diatoms and remains of small sponges. It would thus appear that the curious apparatus of jaws and teeth possessed by this creature is used in a kind of browsing or grazing process, by which it scrapes from submarine rocks the more minute sea-weeds which cling to them, and forms these into solid balls, which are swallowed, and in this state passed through the intestinal canal, where they may be found in all stages of digestion. The sea-urchin is thus a kind of submarine rodent, in so far as its habits are concerned. From these pellets the microscopist may, after digesting them in nitric acid, obtain great numbers of beautiful diatoms (or microscopic plants, for a long time classed with the Infusoria), which are collected by the animal with its food, and whose silicious crusts escape the digestive

*The cut represents the Common Sea-Urchin or Sea-Hedgehog (*Euryechinus drobachiensis* Verrill), one-third of the natural size. A, the eating apparatus seen from above, forming an inverted cone, the apex consisting of the cutting "teeth" or plates, which project out of the mouth-opening, as the animal moves mouth downwards. The five teeth move towards the centre during the act of eating. B, the same seen sideways. C, a single tooth, the lower point forming the cutting edge. D, the same seen sideways, the hook at the upper end with the other four, serving to retain the apparatus (sometimes called "Aristotle's Lantern") in place.

process. Though the sea-urchin is thus a vegetarian, yet near the fishing stations it may often be seen to feed greedily on the garbage of the fisheries, but I have not known it to attack living animals. I fancy that its mode of life at Tadoussac, where it is found in great abundance, may be taken as representing its natural habits, when remote from places where the offal of fisheries and similar matters may be found.

THE ROYAL FAMILIES OF PLANTS.

BY C. M. TRACY.

THOSE who study plants divide them into groups which they call families. This arrangement both expresses very closely the system of nature, and commends itself to the student as being at once pleasant to contemplate and easy to understand.

These families of plants are in one respect like those of men: they have their distinctive characters, and transmit them onward, from generation to generation, with great steadiness; but, as every likeness is apt to be balanced by a difference, these, unlike their human prototypes, never intermingle, but keep a lineal succession more pure and guarded than even that of the children of Israel.

In countries where the "divinity that hedges kings" is more readily admitted and revered than among us, mention is largely made of families termed "royal." By virtue of blood more pure, or strong, or ethereal, than runs in plebeian veins, these are supposed to furnish candidates for the diadem, whose claims are to be adjusted only by and among themselves, no competitor from without being recognized for a moment. Now without stopping to discuss the rights and wrongs of this question in the light of

political science, it is enough to observe, that these "royal families" have always attained their eminence, no doubt, through some high qualification of wisdom, courage, enterprise, or wealth. Some fortunate exhibition of a strong trait has compelled an acknowledgment of prerogative from the popular mass, and this advantage the recipients have been extremely careful to maintain.

On looking over the families of plants, we find royal ones there also. There are four relationships of this kind that tower above all the host that surround them.

> "He above the rest,
> In shape and gesture proudly eminent
> Stood like a tower."

Perforce, we must call them royal. The chief of the four is the family known as the Composites, or, as we prefer to call them, the Asterids.

The eminence of this vast group was very early recognized. The sagacious Ray had, by the year 1700, come to see its greatness so clearly, that, instead of a mere family, or order, he was willing to call it one of the primary divisions of the great Vegetable Kingdom. No other relationship unites such an enormous number of plants. Lindley, in 1853, reckoned the distinct species at nine thousand, and these as making one thousand and five secondary sets or genera. His estimate for the total of all known plants of every sort, is ninety-two thousand, nine hundred and thirty, so that, practically, we shall find just about one of these plants in every ten we may gather, taking the world over. There is no other case that affords any comparison with this. These plants are met with all over the globe, excluded neither from the tropics nor the arctic valleys, and taking rank and position, it seems, very much as suits them, irrespective of latitude. In Sicily, Presl found more than one to every other plant,

or more than half the whole flora of the island. In Majorca and its companion isles, Cambessedes says they are equally plenty. Humboldt reckons every seventh plant in France to be one, every eighth in Germany, and every fifteenth in Lapland; while in North America he finds one in every six, and on the same continent within the tropics, fully one half of the whole. The immense sweep of this family is not seen in location and numbers only. They possess every variety of stature and form. They are annuals, biennials, and perennials; the Daisy and Dandelion have no true stems at all, the Chamomile and the Cudweed are not two inches high, while the Composites of St. Helena are chiefly trees. The Hempweed climbs over bushes, and the Sweet Golden Rod lies flat on the ground. They take possession of all soils; the Marsh Fleabane demands the daily drenchings of the sea, the Dwarf Dandelion affects the dry shelves of rocky uplands, and the Sweet Everlasting is equally pleased with both. Among those of any given division, there is yet no restriction or fetter, for if we look at our garden annuals, we find the Golden Crepis making a mat upon the earth, and the great Sunflower, the most immense of annuals, throwing up its tree-like stem full of enormous flower heads, till, without a figure, "the fowls of the air may lodge in the branches thereof."

But how is this royal order to be recognized by the vulgar? How may the common, unbotanical eye, detect the badge of such a vegetable nobility? Not without some slight examination certainly, yet a slight amount is enough. They are called "Composites" or compound flowers, and this gives the strong point in the case in a word. A Pink or a Potato-bloom is *one flower*. It has only one set of organs composing it, and its fruit, wheth-

er pod or berry, is one and indivisible, though it may contain many seeds. So of the Apple flower and the flower of the Oak, and in short of every other flower whatever, except those of these *Asterids*. These reverse this rule entirely. What appears as one simple blossom in the Sunflower is really an assemblage of several hundreds. Every seed produced in the autumn had its separate and individual little flower, complete in all its parts; for no one of these originates more than one seed, and besides, there are some at the centre that never ripen their seeds, and also a row of broad-leaved, showy yellow ones round the margin that form no seeds at all.

Now these two features—the gathering together of many small flowers in one head, surrounded by a few green leaves, and the production by each flower of one seed and one only—these are two of the three marks that will identify this family everywhere. The third is rather more minute. In all perfect flowers, of every kind, there are two kinds of organs concerned in fertilization, and known as *stamens* and *pistils*. The latter always stand in the centre of the flower, and however numerous they may be, nothing is found interior to them. The stamens, on the contrary, are always more or less in a circle, immediately surrounding the pistils. A stamen consists, usually, of a knob more or less lengthened in its form, termed an *anther*, and borne on a thin stem called its *filament*. The reader need remember no more definitions just now. The third character of the Asterids then is, that in every one of their small flowers the five long anthers of as many stamens grow together round the one pistil, into a straight tube through which the pistil reaches; while the filaments, below the anthers, are wholly distinct.

So, then, the most unpractised hand may identify the

members of this most royal family by these three badges: 1, flowers collected into a compound head. 2, one single seed to each flower. 3, five anthers grown together in a tube round the pistil.

There are but three other families whose structure tends to confound them with these. These marks are even more decisive than the thick lip of the Hapsburghs. The five anthers of the Lobelids grow together just in the way described, but their flowers are never in heads, and their pods have many seeds. The Dipsacids, or Teazles, have flowers gathered in heads in exactly the manner of Composites, but the stamens are entirely free from each other throughout. Then there is a remarkable little family of herbs in South America, known by no common name at all, but we will call them Calycerids. They have small simple flowers in heads too, and single seeds, but the anthers are separate, or nearly so, while the filaments grow together instead. So there is very little need to mistake any of these several orders for the true royal line. The only plant that commonly meets us with any such delusive tendency is the Scabiosa, or Mourning Bride, of the gardens, which belongs with the Teazles. It grows and appears a good deal like a Composite; but if one looks in the centre of one of the small separate flowers, he sees the five stamens all perfectly distinct, and the thing is settled.

A very notable circumstance attending this family, and one going strongly to prove its royalty, is that its whole immense series produces hardly any food for man or beast. Lettuce, Dandelions, and Artichokes are the very best it can do in this way; of less account are Chicory and Salsify, hardly food at all, either of them. There are very few regal houses that boast of less utility. Medicines are not wanting among them; Arnica, Wormwood, and

Thoroughwort have a good reputation, and Chamomile flowers have scented the saddle-bags of every village doctor since the days of the Pilgrims. We will not forget, besides, that excellent oil is obtained from some; such a plant is largely raised in India for this purpose, where they call it Ramtil. Sunflower seed produces oil, it is said, but a species of Madia seems, according to experiments in Europe, to have great superiority as an oil-bearer. Pasquier informs us that it gives as much oil to the acre as Poppies, twice as much as Olives, and thirty-two parts where Linseed yields only twenty-one.

To those who love floral display, however, for its beauty alone, caring little for the degree of more material usefulness that may be found in connection, the great family of the Asterids is a perfect treasure-house. They swarm in every garden, they shine in every green-house, and no bouquet is complete without them. The Sunflower and Marigold bring their "barbaric pomp and gold," the Dahlia, a hundred hues and all splendid, forever tempting the gardener, and forever disappointing him; the Asters have piquant sprightliness, and the Daisies and Feverfews a pure and lovely modesty. Then we have Gaillardias, Pyrethrums, Humeas, Rhodanthes, Cacalias, Gazanias, Centaureas and Catamanches, some of which have common names, and more have none, all replete with beauty, and sure to be favorites wherever flowers are reckoned with the beloved. Nor must there be forgotten, at the end of all, just as "hale, concluding winter comes at last, and shuts the scene," the sterling Chrysanthemums, ever choice with the florist, ever grateful for the gardener's care, ever heedless of frost and chilly wind, and ready to bind a fresh wreath round the brow of the eldest December.

Thus much for the greatest of the Royal Families of Plants. Of the others we may speak hereafter. Their importance is not less than we have ascribed to these, and in some respects they far outvie the great division before us. From the study of their extended ranks we can but gain instruction; from their wonderful involutions there will still shine out a new light on the workings of that Spirit at whose bidding "the earth brought forth grass, the herb yielding seed, and the tree yielding fruit after its kind."

THE MOSS-ANIMALS, OR FRESH WATER POLYZOA.

PLATE 4.

BY ALPHEUS HYATT.

(Continued from p. 63.)

THE blood of the Phylactolæmata is colorless, resembling in this respect that of most of the lower animals. It is composed of the liquid products of digestion, which exude through the membranes of the stomach, diluted with water drawn in through innumerable pores perforating the wall of the tube. The water is the medium of conveyance for the gelatinous, nutritious liquid, probably facilitating its carriage to remote parts.

There is no organ resembling a heart to keep the blood moving, and there are no closed channels, such as arteries and veins, to conduct it among the tissues of the body. The absence of the first is supplied by cilia, which cover the interior of the tubes and cells with a dense, velvety nap, and by their unceasing vibrations sustain a healthy circulation. The course of this may be traced by the numerous floating parasites, beings of the simplest or-

ganization, consisting either of a single cell, or of larger cells containing many others, the cycle of whose lives is passed within the polyzoön, feeding upon its juices. These indicate the passage of a common stream up the branches, and a return current along the free side, which flows into each tube.

Our Polyzoön, also, has no breathing organs, neither lungs or gills to bring the blood in contact with the air, of which element there is always more or less in water, serving there as upon land, for the respiration of animals. The tentacles are supposed to be more especially devoted to this purpose, and the water admitted to the interior must necessarily purify the blood by the air it brings in, but nothing more definite is now known with regard to this function.

The Moss-animals have two modes of reproduction, one by buds, the other by eggs. The former occurs in two ways, by free buds or statoblasts, and by sprouting buds, which develop only in summer.

The statoblasts are destined to carry their burdens of vitality safely through the hardships of winter, and to perpetuate the race by founding new colonies in the spring. They appear at first in the shape of bead-like swellings from the centre of an organic cord, which connects the stomach with the cell (plate 3, fig. 4, and plate 4, fig. 1), passing between the bases of the muscles, which retract the tube. They begin as single cells, but these soon separate into two, then into four, and so on, indefinitely. The accumulated mass then presses to the outer surface of the cord, and becoming invested with a thick, horny, brown envelope (plate 4, figs. 2 & 3, w′), falls off at last into the cavity of the body. This horny sheath in some genera also acquires a solid ring, or an-

nulus (plate 4, figs. 2 & 4, w″), and in others, for example in Pectinatella (plate 4), may have the edge of the ring ornamented with delicate spines furnished with hooks.

Late in autumn the Polyzoön dies, and the statoblasts are set free to float during the long winter, the sensitive germ within being protected from the frost only by their tough coatings. They retain their vitality, however, until the warmth of returning spring awakens their suspended powers of growth. The young Polyzoön then increases in bulk, until it splits the sheath apart, and protrudes beyond the edges. The organs are well advanced when this takes place, and the tube has already acquired its adult habit of retracting the plumes upon the slightest provocation. Its youth is a sunny holiday passed in the open water, where it swims freely by the aid of cilia, which clothe the outer surface, but the sides of the statoblast are finally separated so widely, that they drop off, and the wanderer seeks a resting-place under some old log or stone. Here a little gelatine, which subsequently becomes the tough, brown envelope (plate 3, D), fastens it to the surface, and henceforth its fate is inseparably linked to that of an inanimate mass. When securely anchored, and in some cases while still free, a little bulb appears externally on one side, and, growing larger, stretches into a minute cell, within which a young polyzoön is discernable. This was primarily a tiny, saclike bud, formed by the bending inwards of the wall in the parent cell, close to the bases of the muscles of the fold (plate 1, fig. 5, Y). The throat and stomach are derived from the transverse division of the minute sac into two portions, but it remains to be ascertained whether the intestine is made by an after-growth from the stomach, or by the division lengthwise of the throat. The tentacles

arise from the thickened rim, and draw out between them a web, which afterwards receding externally, becomes the veil, and the wall of the tube is merely an elongation of the membrane connecting the rim of the sac with the parent.

The cell-bulb does not protrude externally until these organs are mapped out. The young one, though still very imperfect, begins to stretch forth its arms as soon as the cell, or cœnœcium, as it is more appropriately called, is well extended, and long before the characteristics reach perfection, gives other evidences of its natural precociousness in the statoblasts and regular buds, which spring up in their respective places within the cœnœcium. At intervals two buds will sprout in different directions, originating new branches, and thus a dendritic colony is gradually built up, which owes its origin entirely to one animal. Consequently the outer branches are the youngest, and often, as in plants, these are vigorous and quick with life, while the parent trunk is but an empty case, frequently with nothing left to indicate its position but the decaying cœnœcia, or their faint tracery in the slime.

The second mode of reproduction, by eggs, takes place only in the newly established colonies during the earlier summer months. These eggs are little colorless vesicles, developed internally from a bead-like swelling on the free side of the wall, near the orifice. When ripe they are dropped into the cavity of the cœnœcium, and there meet with the fertilizing filaments which have been developed from a similar bud upon the organic cord. We perceive from this that our polyzoön is, physiologically speaking, neither male or female, but of the collective gender, an hermaphrodite, combining the reproductive powers of both sexes.

The eggs eventually attain the size of a statoblast (about one-thirtieth of an inch long), and have an oval outline. When full grown, their exterior is also clothed with cilia, which render them capable of rapid motion, and at this period they may be sometimes seen squirming in the tube, and tossing the stomach about with great violence. No orifice for their emission from the body has been discovered, and we have every reason to believe there is none, and that they force their way into the world directly through the walls of the body. In fact, Mr. Albany Hancock, an English naturalist, has observed a full-grown egg, which obtained its liberty by pressing through the closed orifice of the cell, rending and destroying the parent in its course.

The cœnœcia, composing the trunks of the older colonies, are always empty, as previously stated, in the autumn, and it is not improbable that they are the remains of the unfortunate parents whose death was caused earlier in the season by their restless offspring, since all, even the younger autumnal polyzoa are incapable of bringing forth eggs, and produce only statoblasts and regular buds.

The polyzoön is developed from an internal bud at one end of the egg, and when sufficiently large bursts the outer envelope, coming forth like the polyzoön of the statoblast, armed with abundant cilia, by whose aid it swims. Like this, also, after a time its wandering ceases; it seeks some dismal retreat, glues itself to the surface, and becomes the progenitor of a new colony.

All Polyzoa, both marine and fresh water, in common with other attached and branching forms, such as the corals among the Radiata, have been called Phytozoa, or

plant-animals, but, like all others of this kind, their young, born from the egg, are free.

Although thus resembling corals, they are widely separated from them by their structure. Each little animal, when reduced to its typical form, is a simple sac containing the stomach, and is allied to the clam, the oyster, and the snail, all of which have the same plan of structure. The coral, as may be seen by looking closely into any one cell, has a number of thin plates all pointing from the rim toward the vacant centre, like the spokes of a hubless wheel, and is, therefore, related to the star-fish, jelly-fish, and others, which have the parts arranged in a star-like or radiatimg manner. Thus, while by a process of budding, animals may be grouped into shrub-like colonies, with an external resemblance to each other and to the plants, with which the older naturalists classed them, their internal structure may show that they belong not only to animals, but to very distinct branches of the animal kingdom.—*Concluded in next number.*

EXPLANATION OF PLATE 4. *Pectinatella magnifica* Leidy.

Fig. 1. Enlarged view of one polyzoön, situated on the end of a branch, which in Pectinatella (see No. 2 of this Magazine) is only a hollow lobe. A″, cavity of this lobe; D, mass of gelatine below; E, wall of this lobe and tube; J, brown stripes in the stomach, the hepatic folds; M′, M″, muscles for withdrawing the tube, retractors; N, N′, muscles of the fold, which in this species is very narrow.

Figs. 2. 3, 4, the upper and lower side, and profile view of the statoblast; W′, horny sheath; W″, annulus; W‴, spines with hooks.

HYATT ON THE MOSS ANIMALS.

THE TARANTULA KILLERS OF TEXAS.

BY DR. G. LINCECUM.

The Mud Dauber, *Pompilus formosus*. From SAY.

An investigation of the extensive family of Mud Daubers would be an interesting and instructive study. It would necessarily include that of the various types of Spiders, from the great hairy Mygale Hentzii, down to the smallest, almost microscopic species; for nearly every type of Spiders has its special enemy among the Mud Daubers.

The large, red-winged "Tarantula Killer" (the *Pompilus formosus* of Say) is, as far as I know, the largest of the dauber group. It takes its prey by stinging, thus instantly paralyzing every limb of its victim. The effects of the introduction of its venom is as sudden as the snap of the electric spark. The wasp then drags it, going backwards to some suitable place, excavates a hole five inches deep in the earth, places its great spider in it, deposits an egg under one of its legs, near the body, and then

covers the hole very securely. A young Tarantula Killer will be produced from this egg, if no accident befalls it, about the first of June of the ensuing year.

This large and conspicuous insect is everywhere in Texas called the Tarantula Killer, and is over two inches in length; the head, thorax, abdomen, and long spiny legs are all black, while the wings are sometimes of a bright brown, with black spots at the tips. It is armed with a formidable sting, which it invariably uses in taking its prey. This sting does not kill the Mygale, but paralyzes it—suspends all animation—and in this state, in a dry place, and at the proper temperature, it is in a condition to resist decomposition a long time. The entire group of Mud Daubers possess the power of paralyzing their victims, and in that condition they store up their spiders, caterpillars, and other insects, which are to serve as food for coming generations.

The Tarantula Killer pursues several other species of the large ground spiders, but the Mygale Hentzii, or Tarantula, is his favorite.

I have sometimes found under shelving rocks, and other sheltered places, dauber's nests that were doubtless several years old. In some of the cells, where the egg had proved abortive, the spiders were there, still limber, with no signs of decomposition about them. They did not seem to be dead, but looked as if they could almost move their legs, and were perhaps not unconscious of their deplorable condition. I should be frightened at the prospect of being stung by any of the larger types of this group of insects. I have, however, known but a single instance of this kind. Several years ago a person was stung by a common black dirt dauber on the shoulder near the neck; he complained of numb-

ness in the part for a distance of some inches around the wound, but of no pain. Its effects lasted about twenty-four hours. I think it quite probable that the large Tarantula Killer would produce a more serious inconvenience, and perhaps paralyze the whole system. The

Mygale Hentzii, the Tarantula of Texas. From MARCY.

Pompilus, however, is a good-natured insect, showing no signs of pugnacity, except when she has a fine fat Tarantula in hand, and then she only threatens violence by spreading out her red wings, and running a little way

towards the intruder. She is quite tame, and will come familiarly in and about one's yard and house, dragging the prostrate Mygale under the floor, where she hides it from the intrusion of other Tarantula Killers, who would, if they could find it, take out the egg and put one of their own in its place, as they are remarkable for such thieving propensities.

The Mygale Hentzii, on the other hand, sometimes succeeds in capturing his great enemy, as I once noticed. When first observed, the Mygale had the Tarantula Killer, still alive, in his mouth, holding it by the back. The Tarantula seemed to be greatly elated at its success, which it manifested by capering about, and performing various other antics, such as running suddenly at any thing or person that came near it, holding on to his victim all the time. The Tarantula Killer appeared to be conscious of her condition, and was, as far as I could discern, fully resigned to her fate, remaining perfectly quiet. I regretted that I could not wait to witness the finale of this affair: such cases do not often occur.

The Tarantula Killers have severe fights with each other. It occasionally happens, when one of them succeeds in capturing a Tarantula, that another one, or more, flying around in that vicinity, and smelling the odor that arises from the Tarantula Killer when she uses her sting, which resembles the odor of the paper-making wasp (Vespa), only much stronger, takes the scent like a dog, tracks the Tarantula, following it up closely, and makes a violent effort to get possession of the paralyzed spider. A fight ensues, which occasionally terminates in the death of both parties; at other times the contest lasts but a little while, as the stronger party drives off the weaker, and takes possession of the prey.

It is surprising to one who has been educated to believe that the faculty of reason belongs alone to man, to contemplate the consummate ingenuity which is displayed by these insects in their efforts to secure their eggs from the observation of their own thieving sisters, and to hide the food they have provided for their young during the period of its existence under ground.

The Tarantula Killer feeds upon the honey and pollen of the flowers of the Elder, and of *Vitis ampelopsis*, the Virginia Creeper; but its favorite nourishment is taken from the blossoms of Asclepias quadrifolium. This species of Asclepias blooms through the summer, and the Tarantula Killer seems to know the locality of every plant. If one finds on the prairie a plant of Asclepias quadrifolium in bloom, and watches ten or fifteen minutes, he will be almost certain to see a Tarantula Killer come to it. This insect requires considerable food, as its period of life extends from the first of June until November, or till the frost destroys all the flowers, when it seems to die for want of food, as it is often seen at this time crawling about in a very feeble state. I do not think any of them ever survive the winter, as they never appear earlier than June.

THE BIRDS OF SPRING.

BY J. A. ALLEN.

The arrival of our birds during the spring is by no means uniform; a certain number coming one week and an equal number the next, either in the accession of species or individuals; nor is the increase regular and uninterrupted. At first the comers are uncertain, both as regards number and the time of arrival. The few that

appear in March would scarce attract attention if appearing with the hosts of May, while now the animation they afford our fields and roadsides is in agreeable contrast with the dearth of bird life in winter. April brings larger additions, and May bursts upon us with such a profusion of species, that on all sides we are greeted with fluttering, restless wings and lively notes. But the increase has its intermissions; the first genial period attracts a few, but through the succeeding colder weather their numbers for weeks may scarcely increase, perhaps, indeed, if the cold prove quite severe, actually decreasing, while a following unusually mild term hastens on many that seem to have been awaiting a favorable opportunity. A cold norther occurring early in May, impedes for days the thousands of Warblers and Flycatchers that are accustomed then to migrate. The storm perchance closing at nightfall, a mild night ensues, and with the next day's sun the woods are alive with little industrious insect hunters, that the day before the most prying observer would fail to have detected; they increase with the advance of the day, and towards night the collector finds some species common, that he had looked in vain for in the morning, and the hedges suddenly become vocal with their notes.

Our limits would not allow us even to enumerate all the insectivorous species,—the friends of the orchardist, the gardener, the farmer, in short, of our race,—and much more to describe their pleasing colors, their inspiriting songs, and their hundred interesting peculiarities of habit and mode of life; how some hunt their prey, creeping among the foliage, others pursue it in the air, or suddenly dart upon some unlucky insect as it passes their perch. Among the woodland species the very names of the warblers,—the Black-throated Blue, the Black-throated

Green, the Chestnut-sided, the Bay-breasted, the Yellow Red-poll, the Black-poll, the Nashville, the Cape May, the Golden-crowned, the Orange-crowned, the Blackburnian, the Golden-winged, the Spotted Canada, the Redstart, etc., some of them scarce, but most abundant for a brief period in May,—are suggestive of all that is beautiful in birds: gay plumage, useful habits, and sweet warbling notes.

Among the more common and well known later emigrants, we welcome the Bobolink to our meadows, which he alone would render attractive. Brimful of animal spirits, he gaily fiddles away all the day long, perched on some tree or fence in his favorite bogs and meadows, or indulges in coquettish gambols in the air, meeting us in our walks as we approach his grounds with a confident outburst of tinkling drollery, so varied and fanciful we half imagine it to represent personal allusions of either flattery or derision. We welcome the gorgeously colored Oriole, and the chaste-robed Vireo to the orchard, where the loud trumpet notes of the former, and the soft, soothing warble of the latter, render them as agreeable as their services are valuable to the fruit-grower. We also welcome the Red Mavis, or Brown Thrush, to the hedges, the clear-voiced Veery to the swamps and moister woodlands, the twittering swallows to their homes under the eaves and in the barn lofts. Not least valued by lovers of the picturesque is the Whippoorwill, which, from the roof, the well-curb, the door-yard fence, or the remoter precincts of the woods, is heard during morning and evening twilight, or at intervals throughout the moonlit night.

During the spring months we have with us nearly every species of bird that ever visits us during the entire year, embracing of course all the resident kinds, as well as all the migratory, except a few transient winter visitors;

even the greater part of these latter may be found, if not every year, at least occasionally during the early part of March. The migratory species constitute two classes, according to their range in the breeding season, viz.: those species that spend the summer with us, and those that altogether pass farther north. Compared with the birds of winter, they embrace a very much greater proportion of common species, while nearly all are regular, if not abundant visitors. The proportion of rare species is but thirty-five and one-half per cent., instead of seventy-six per cent. as in winter. The number of rapacious species has hardly increased, but the insectivorous, instead of being extremely few, now constitute, taking only those strictly insectivorous, fully one-half the whole, and the diet of this remaining half (especially among the land birds) is mainly composed of insects.

Such are some of the changing phases of bird life in our varied climate. In the following tabular statement we give a further summary.*

Whole number of species (in Spring), ...			280
Common, " "			190
Rare, " "			90
Migrant, " "			250
Resident, " "			30
Migrants that spend the summer in Southern New England, . .	Land Birds,	136	
	Water "	36	
			172
Migrants that pass the summer farther north, ...	Land Birds,	28	
	Water "	80	
			108
Birds of Prey (number of species), ...			18
Cuckoos, Woodpeckers, Night Jars, and their allies, .			15
Flycatchers, Thrushes, Warblers, Swallows, Vireos, Wrens, etc., .			77
Finches, Orioles, Blackbirds, etc., ...			40
Pigeons and Grouse, ...			6
Herons, Plovers, Sandpipers, and Rails, . . .			50
Ducks and Geese, ...			37
Gannets, Gulls, Shearwaters, Terns, etc., . . .			22
Divers, etc., ...			13

* Designed for the North-eastern States of the Union.

FEMALE OF THE AMERICAN SILK WORM.

TELEA POLYPHEMUS.

MALE OF THE AMERICAN SILK WORM.

TELEA POLYPHEMUS. [After HARRIS.]

THE AMERICAN SILK WORM.

BY L. TROUVELOT.

(Concluded from p. 95.)

Rearing of the larva in the open air. There are different ways of raising the wild silk worms. I have for two years cultivated them in the open air. I had about five acres of woodland enclosed by a fence eight feet high; a net was stretched over the bushes, which were of six or eight years' growth. This net, supported upon posts, was intended to protect the worms from the depredations of the birds. The eggs were put upon the bushes in the little hatching-box, so that after this, there seemed but very little to do. But it was not so: over so large a space, it was impossible to keep the net in good order, and the birds managed to get under it; the small ones could go through the meshes, and the larger ones through some holes in the old net, so I was obliged to chase them all the day long, as when pursuing them on one side they would fly to the other and quietly feed, until I again reappeared. Thus, besides the insect enemies enumerated above, many of the caterpillars fell a prey to the birds.

Rearing them under a shade. This year I made a shade open on all sides, protected by a roof to keep out the hot rays of the sun, and boards were arranged so that they could be raised up from the roof to give more light when the sun was behind the clouds, and also at morning, evening, and at night. This shade had a very fine net around it, so that it was impossible for the birds to get through the meshes. In this way an oak branch can be kept fresh for four or five days; a branch is placed in every two holes, so as to leave a vacant one between any two branches. When the foliage of one branch is nearly eaten up, a fresh one is put into the vacant hole, and small

twigs, going from the old branch to the fresh one, are placed so that the worms can cross upon it without descending upon the table. When the worms are attached for the purpose of moulting, they should not be disturbed or taken away from the place where they are, as they could not so easily change their skin. Three times a day the excrements should be swept from the table. In warm days some water should be sprinkled with a watering-pot upon the leaves, as the worms are fond of drinking water. The worms should be handled as little as possible, and only when it is absolutely necessary. The space that remains open between the branch and the table should be filled with paper or hay, so that the larvæ may not crawl under the table, as they would be drowned in the water contained in the bottle.

For cultivating Silk Worms upon a large scale, it would be very well to select a place with a brook running through it, as the water could be made to flow under the table, in reservoirs, where the branches could always dip in fresh water; as the water put in the bottles is soon corrupted, and the branches absorb much of it, they need to be filled up several times a day.

When a cocoon is well begun, the best way will be to separate from the branch the twig and leaves between which it is built, so that other worms will not disturb the larvæ working inside; this cocoon should be placed upon lines stretched for that purpose in a special room, where the sun cannot reach it. Ten or twelve days after, they will be completed, and may be placed in baskets, and kept as I have indicated above.

Some experiments made on our Silk Worm show how hardy it is, being the easiest of all the silk worms to take care of. Chrysalids were put into a tin box,

which was placed in another box containing ice and salt; the temperature soon descended to four degrees below zero. They were allowed to remain in this refrigerator for half an hour. When taken out, the chrysalids were as hard as a piece of ice; they were immediately put into a cold room. Several days after this, the temperature of the room being above the freezing point, the chrysalids gave signs of life by moving the abdomen. Some years ago, wanting to keep a cocoon in my collection, I thrust a pin through it, and it passed through the body of a living chrysalis inside of it; this was done in the month of October. Nine months after, in June of the following year, I was astonished to find a great commotion in one of the boxes of my collection; all the specimens were broken, and I found the cocoon which had been pinned in the box, detached and open at one end, and the antennæ, head and legs of the moth projecting out of it; the insect was still living and could not come out, as the pin passing through it had also transfixed the cocoon. Through this insect had been thrust, for nine months, a pin covered with verdigris, and yet had not been killed by it! Naturalists state that it is very important, when transporting cocoons in a box, to pierce the box with holes so that the air may penetrate it, as if air was needed for a chrysalis inside the cocoon. Having observed how close and air-tight the cocoon of the Polyphemus seems to be, I could not conceive that air was needed for it to breathe. Desirous of ascertaining whether my idea was correct, I took three cocoons, and at two different times I covered them carefully with a thick coating of starch, allowing the first coating to dry before putting on the second one. After this the cocoons were covered at three different times with a heavy coating of shellac varnish; thus the cocoons

were made perfectly air-tight. They were kept in a cold dry room all winter. In July the moths came out perfectly healthy, the fluid they discharge through the mouth having perfectly dissolved the starch and varnish. So these insects had been nine months with no air, except the very small volume enclosed in the cocoon, and they had accomplished their transformation just as well as if the air had been allowed to come into the cocoon.

It seems to me that when once enclosed in the cocoon, the pupa is in a transitory state. The process of assimilation, at least during the cold days, seems to have ceased. In the stomach of chrysalids can be found an albuminous, greenish substance; probably it is a food which can be assimilated, or at least transformed into some of the liquids which are discharged by the perfect insect when coming out of the cocoon. If there is any elaboration of the food in the chrysalis, the process must be very slow, and surely no air is needed to accomplish it, nor any food, except what little food is in the stomach. The most striking phenomena manifested by life is the assimilation and elimination of food; but to assimilate, the animal must take food, either in the solid or gaseous form. We know that the chrysalis cannot eat; breathing is very problematical. Before changing into a chrysalis, the worm evacuates all the contents of its stomach; so, in my opinion, the chrysalis does not breathe, or if at all, it is so very slight as to be insignificant.

There is not much possibility of being able to obtain two broods of the Silk Worm in the same year in this latitude. The earliest date at which I have obtained cocoons was the first of August, twenty-two days after the moth hatched from the cocoon. On the fifth of September I had young larvæ, but the heat being less in this

month than in July and August, the larvæ did not grow so rapidly, and the moulting did not take place so regularly. The first moulting took place on the fourteenth day, the second the twenty-third day, the third the thirty-sixth day; on the first of November, or fifty-six days after their birth, they had not accomplished the fourth moulting. I could not continue the experiment, as I left for Europe the second of November; but they had frozen several times, and the leaves were very hard, in fact I do not believe that the second brood would have come to maturity. I do not see that it would be of any advantage to obtain two broods, as the moths do not all come out of the cocoon at the same time, but sometimes there are two months between the first and the last; so the process of rearing can go on permanently all summer, which is equal to having two broods.

Cocoons can be retarded in hatching out by being put in a very cold room—an ice-house, for instance; in this way they can be made to hatch another year, or nearly twenty-one months after they have been in the cocoon. In fact, the time of their appearance can be put back for an indefinite period, as life is nearly suspended. Reaumur states, that, at the time he was writing, he had in his cellar pupæ which had been there for five years, which were still living. I have myself kept pupæ of sphingidæ, or hawkmoths, for three years in my cellar. At the time I went to Europe, they were still living, but on my return I found that the rats had eaten them.

THE LAND SNAILS OF NEW ENGLAND.

BY EDWARD S. MORSE.

HELIX TRIDENTATA *Say*. (Figs. 8, 9.) The shell of this species is depressed, and of a yellowish horn color; whorls

Figs. 8, 9.

five or six, slightly convex. Aperture contracted by the reflected lip, which has two teeth, and with a curved tooth on the inner lip forms a trilobed aperture. The whorls are obliquely striated, and the umbilicus is open. Diameter about one-half an inch. The animal is of a dark bluish slate color. This species is widely distributed throughout the United States, but is not common in New England. It has never been found in Maine, or New Hampshire, or in the eastern part of Massachusetts, and occurs only rarely in the western part of the last-mentioned State. Dr. Binney states that he has most commonly found it under layers of wet and decaying leaves in forests.

HELIX PALLIATA *Say*. (Figs. 10, 11.) Shell depressed, dark brown or chestnut color, covered with minute stiff

Figs. 10, 11.

hairs which give the surface a roughened appearance. Whorls five, flattened above; aperture three lobed, much contracted by the lip and teeth. Lip widely reflected, with two projecting teeth on the inner margin; the one at the base long and slightly prominent, the one above acute and prominent; inner lip having a broad white tooth projecting downward from the shell; umbilicus covered by a white callus, being an extension from the lip. Diameter nearly one inch. Animal blackish slate color. It is found in Vermont at Copperas Hill, and is common in the

Western, South-western, and Atlantic States, with the exception of New England, as far south as South Carolina.

HELIX MONODON *Rackett.* (Figs. 12, 13.) Shell light russet in color; whorls five or six, closely revolving; aperture flattened, contracted by a deep groove behind the lip. The lip is narrow, and turned back, partially or wholly covering the umbilicus. On the inner lip there is a long white tooth at the aperture, and within the aperture, projecting from the umbilicus, a shelly partition called the fulcrum. The shell is covered with numerous minute hairy projections, which give the surface a velvety appearance. The diameter of the shell is usually three-eighths of an inch. Animal yellowish-brown, darker on the head and back. In some parts of New England this species is quite common. Found in forests and also on hill-sides in pastures, under bits of bark and stones, a situation in which it is unusual for other snails to occur. Two or three individuals are generally found together.

Figs. 12,13.

HELIX HIRSUTA *Say.* (Figs. 14, 15.) Shell nearly globular, brownish in color, covered by numerous rigid hairs. Aperture contracted, and nearly closed by a long narrow tooth on the body whorl; lip narrow, turned against the outer whorl. On the inner margin of the outer lip, at the base of the aperture, is a deep notch. Ordinary diameter one-quarter of an inch; umbilicus closed. Animal whitish, head and tentacles slate colored. In the New England States this species has been found west of the Connecticut River, though not common. It is common in the Middle and Western States.—*To be continued.*

Figs. 14, 15.

NOTE.—In explaining the parts of the shell in the first number, Fig. 1, the following references were accidentally omitted: A, *aperture.* T, a shelly projection within the aperture, called the *tooth.*

REVIEWS.

Observations upon the Cranial Forms of the American Aborigines. By *J. Aitken Meigs, M. D.* Philadelphia, 1866. pp. 39. 8vo.

The valuable observations here recorded are based upon the large collection of skulls belonging to the Academy of Natural Sciences at Philadelphia, largely consisting of the celebrated Morton collection. The author's conclusions, however, derived from a study of this and other materials, lead him to state that "it becomes very probable that there is for the American variety of man neither unity nor genetic isolation." It is well known that Dr. Morton advocated strongly the diversity of the origin of Man, and the uniformity of the American type of skulls; i.e., that the Indian is a distinct species from the Esquimaux, Negro, or Caucasian, and was created on the soil he now inhabits. But M. Alcide D'Orbigny, with his observant eye and rare experience as a traveller in South America, contended that the races he saw there were as diverse as those of Europe. This view, extended to all the American races, was shared by Blumenbach, Lawrence and Pritchard, and others, especially Dr. Desmoulins and Bory de Vincent, two French Ethnologists.

More recently, the late Prof. Retzius, a Scandinavian ethnologist of high standing, criticised Dr. Morton's views, saying that "there is scarcely any part of the world where such contrasts are to be found between *dolichocephali* (long-headed skulls) and *brachycephali* (short or square-headed skulls) as in America!" Dividing the American races into three types, he "traces the pedigree of the Esquimaux into Asia, among the Chinese population, the transitionary link being the Aleutians. The dolichocephalic Indians (our eastern tribes) he assumes to be related to the Guanches of the Canary Islands, and the Atlantic tribes in Africa, as the Moors, Berbers, Tuaricks, Copts, etc., which are comprised under the Amazirgh and Egyptian Atlantidæ of Latham. The American brachycephalic tribes which belong chiefly to the side of America looking towards Asia, the Pacific Ocean, and the South Sea, are allied, he thinks, to the Mongolian nations." D'Omalius d'Halloy, Latham, and, more recently, Wilson, the author of "Prehistoric Man," have stated their belief in the diversity of the American races.

Our author gives many facts of much interest to the special student, and thus sums up his conclusions:—*

1st. That the crania of the Aboriginal Americans are divisible into Dolichocephalic, Mesocephalic, and Brachycephalic groups.

2d. That the Dolichocephali greatly preponderate in numbers over the Mesocephali and Brachycephali.

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*Human Skulls are divided by Ethnologists into two categories; namely, those that are long and high, *dolichocephalic*, and the square, short forms, called *brachycephalic* crania. The author uses the term *mesocephalic*, to signify a form of skull that is a medium between the two primary forms.

3d. That in the case of the Peruvian skulls in the Academy's collection, however, the short, square heads are more numerous than the elongated forms.

4th. That in North America neither the Dolichocephalic nor Brachycephalic tribes, when first known to Europeans, were restricted in their geographical distribution to any particular locality. While the former were scattered over the continent, through all degrees of latitude and longitude; the latter appear to have been, if we may judge from the specimens in the Museum, more numerous about the Great Lakes, at various places in the interior, in the south near the Gulf of Mexico, in the so-called Paduca area, and especially along the north-west coast. In general terms we may say that on the eastern or Atlantic side of the continent the Dolichocephali appear to have prevailed; and on the western or Pacific side the Brachycephali. This, in a great measure, seems to have been, and still is, the case in South America.

5th. That long and short-headed tribes or races are very commonly found throughout the two Americas side by side. In the extreme north, for example, dolichocephalic and brachycephalic forms are contrasted in the Esquimaux and their geographical neighbors, the Konaegi or Kadiakan Aleutians; and again in the far south these diverse forms are exhibited in the Patagonians and Puelches.

6th. That this contrast in cranial forms existed among the extinct races of America, as it now does among extant tribes.

7th. That in comparing the old and new worlds by their cranial forms, we find that while in Europe and Asia the brachycephalic is the prevalent form, in North America the dolichocephalic is the predominant type.

8th. That while in Africa all the people are dolichocephalic, in South America they are nearly equally divided between the long and short forms.

9th. That while in Europe and Asia the Polar or Arctic people are chiefly brachycephalic, in America they are wholly dolichocephalic.

10th. That various European, Asiatic, and African crania, such as those of Norwegians, Swedes, Anglo-Saxons, the Germanic or long-headed Germans, the Gothic or short-headed Germans, the Finns, Lapps, Turks, Sclavonians, Kalmucks, Burats, Prognathic Negroes, etc., find representatives among the native cranial forms of America.

11th. That this homoiocephalic representation is not confined to normal skull-forms, but is shown in abnormal or artificially distorted skulls also.

12th. That the Dolichocephali are divisible into at least six well-marked forms or types; namely, the pyramidal, boat-shaped, oval, cylindrical, oblong, and arched.

13th. That the Brachycephali may be divided into round or globular, and square or cuboidal classes.

14th. That the Mesocephali also consist of two sub-groups, one of which is transitionary to the square or cubical, and the other to the round or globular Brachycephali.

15th. That these ethnical or typical groups are founded upon osteological differences as great, and apparently as constant, as those which, in Europe, suffice to separate the Germanic and Celtic stocks, on the one hand, from the Ugrian, Turkish, and Sclavonian, on the other.

A TREATISE ON SOME OF THE INSECTS INJURIOUS TO VEGETATION. By *T. W. Harris, M. D.* Third Edition. Boston. Crosby & Nichols.

The publication of this work, aside from his strictly scientific papers, secured to the author a high reputation as an entomologist, as he was one of those few naturalists who specially studied the *habits* of insects, as well as their structure and classification. So richly illustrated a volume, aside from its great value as being the best introduction to American Entomology, and as forming a practical treatise on our noxious insects, must always claim for it a large circulation. We owe to the courtesy of the Editor the privilege of using several illustrations, which are duly credited in their appro-priate places.

NATURAL HISTORY MISCELLANY.

BOTANY.

THE "MAY FLOWER." — Among all that beautiful family of plants, the Heaths, there is none that has such strong claims upon our regard as the lowly May Flower, and none more likely to have its claims vindicated; for, to a certain extent, it has already become historical, in conquence of its association with the Pilgrims, or more properly with the Pilgrim ship "May Flower." This humble shrubby plant grows plentifully around Plymouth, and in piney woods in many other localities along the New England coast. Its "starry loveliness" could hardly have failed to arrest the attention of our worthy forefathers, whose high purposes and imperative necessities left so little room for the play of sentiment. Even in that austere age, we doubt if it were frowned upon, as much of a sin, if the young Puritan, on his way to the meeting-house, chanced to tuck a sprig or two into his doublet, in expectation that the eyes of some Mary or Martha, who perchance sat on the opposite bench, weary perhaps with watching the slow-moving sands of the hour-glass on the pulpit, — might look the more graciously upon him.

In the books, this plant is known as the "Epigea repens," but otherwise as the Trailing Arbutus, May Flower, and Ground Laurel. Under whatever name, however, it is sweet and lovely, and has such a rich, spicy fragrance, that we wonder how the fickle suns of April could possibly draw from the cold ground aroma of such delicacy.

Pretty little branches of this early gem may now be purchased along the thoroughfares, and at the flower-shops of Boston. Sweet harbinger of Spring, pleasing souvenir of the season, go on your mission of gladness, as young men and maidens, old men and children welcome your return, and bear them away to homes of affection and regard, laden with whisperings of joy to the young, hope to the afflicted, rest and peace to the weary and aged; to homes where every one, as in the words of a certain poet of New Bedford, may be strengthened and confirmed in every good impulse of patriotism and devotion!

"Dear to my heart, thy rock-ribbed hills,
Thy valleys green, thy gentle rills,
Thy sunny nooks, where 'neath the snows,
The fragrant Epigea blows.
And tempts, 'ere winter yields her sway,
The blooming maidens steps away,
In many a wooded warm recess,
To seek its starry loveliness."

G. D. P.

PARTHENOGENESIS IN THE WEEPING WILLOW. — Herbert Spencer, in "The Principles of Biology," states that the Weeping Willow multi-

plies for an indefinite period by *agamogenesis* (or birth without a previous union of the male and female elements). This tree, "which has been propagated throughout Europe, does not seed in Europe."

On the Period and Ratio of the Annual Increase in the Circumference of Trees.—"The Carolina Poplar (*Populus monilifera* Ait.) was selected on account of its rapid growth, enabling me to easily note the increase of circumference each seven days. The results tabulated, show that—

"The tree increased in growth only during the three months between the middle of May and the middle of August, and that the ratio of growth is much greater during the month between the middle of June and the middle of July, than during the month preceding, and the succeeding months."—T. Meehan, *Proceedings of the Academy of Natural Sciences, Philadelphia, October*, 1866.

The Agency of Insects in Fertilizing Plants.—I have made some observations and experiments on the fertilization of Phænogamous Plants, showing that in the genus *Kalmia*, and other genera also, insects are necessary to carry pollen from flower to flower in order to fertilize pistils.

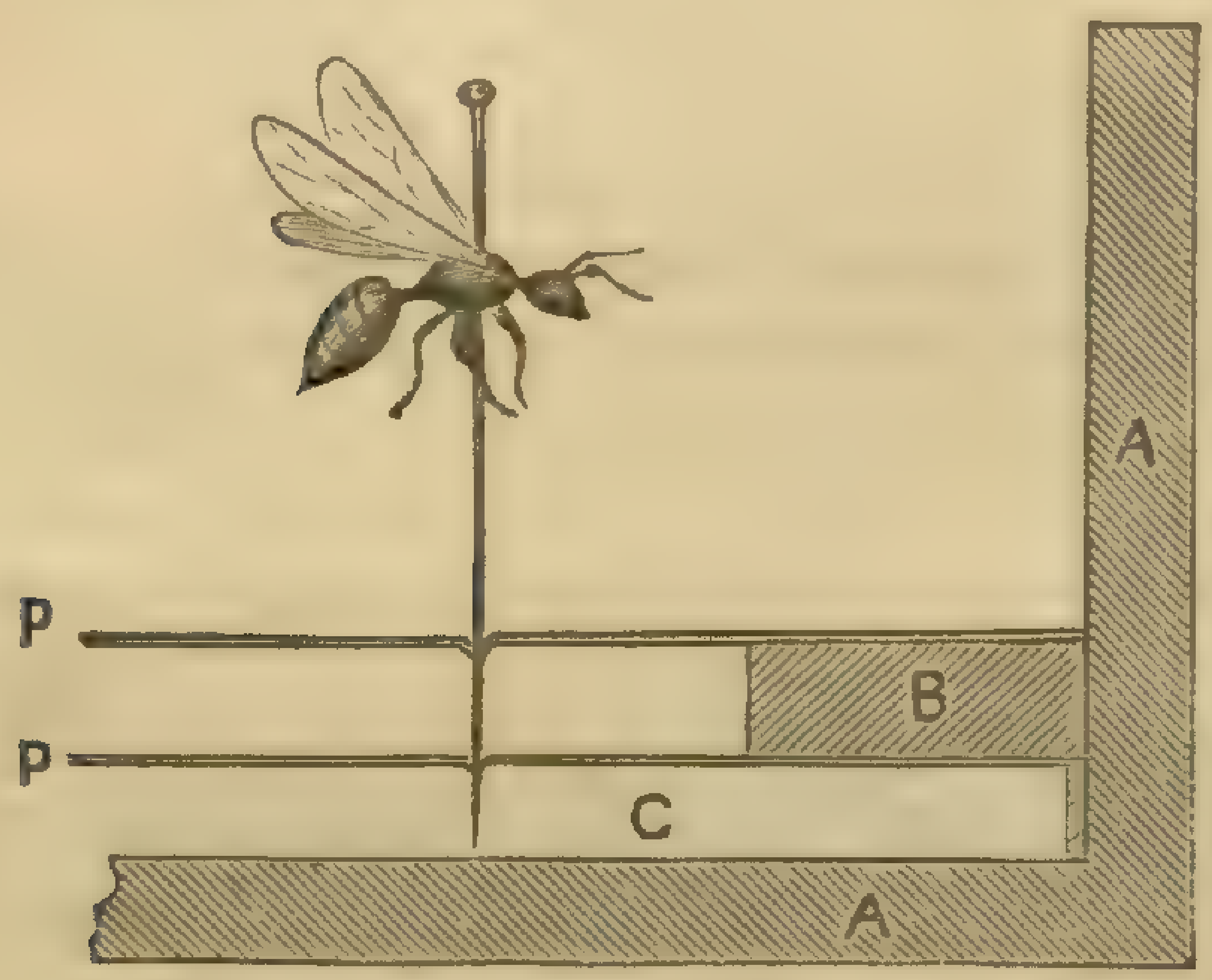
I have found, also, that of many plants which produce perfect flowers, in some the stamens discharge all this pollen before the stigmas of the same flower are exposed; while there are others in which the pistil is fertilized before the pollen of the flower is discharged. In these two ways they act as though they were monœcious plants.—W. J. Beal.

Curious Flower.—One of the most singular flowers growing in this pretty garden (of the Panama Railway Company) was an orchid, called by the natives "Flor del Espiritu Santo," or the "Flower of the Holy Ghost." The blossom, white as Parian marble, somewhat resembles the Tulip in form; its perfume is not unlike that of the Magnolia, but more intense. Neither its beauty nor fragrance begat for it the high reverence in which it is held, but the image of a dove placed in its centre. Gathering the freshly-opened flower, and pulling apart its alabaster petals, there sits the dove; its slender pinions droop listlessly by its side; the head inclining gently forward, as if bowed in gentle submission, brings the delicate beak, just blushed with carmine, in contact with the snowy breast.—J. K. Lord's "*The Naturalist in Vancouver Island.*"

ZOÖLOGY.

Mimetic Forms among Insects.—Among the living objects mimicked by insects are the predaceous species, from which it is the interest of the mimickers to be concealed. Thus, the species of Scaphura (a genus of Crickets) in South America resemble, in a wonderful man-

ner, different Land Wasps of large size, which are constantly on the search for crickets to provision their nests with. Another pretty cricket which I observed was a good imitation of a Tiger Beetle, and was always found on trees frequented by the Beetles (*Odontocheilæ*). There are endless instances of predaceous insects being disguised, by having similar shapes and colors to those of their prey,—many Spiders are thus endowed; but some hunting Spiders mimic flower-buds, and station themselves motionless on the axils of leaves and other parts of plants, to wait for their victims.—H. W. BATES, *Linnæan Transactions*, 1862, p. 509.



A NEW INSECT BOX.—The necessity for a cheap, and efficient insect box, has long been experienced by collectors. Sheet cork is not only expensive, but oftentimes difficult to procure; linings of pith require a good deal of management to make neat and even surfaces. The following plan is offered, after testing its merits for several years, not only in cases used for the transportation of specimens, but in those intended for permanent exhibition. A box is made of the required depth, and a light frame is fitted to its interior. Upon the upper and under surfaces of this frame, a sheet of white paper (drawing, or log paper answers the purpose) is securely glued. The paper having been previously dampened, in drying contracts and tightens like a drum-head. The frame is then secured about one-fourth of an inch from the bottom of the box, and the pin is forced down through the two thicknesses of paper, and if the bottom of the box be of soft pine, the point of the pin may be slightly forced into it. It is thus firmly held at two or three different points, and all lateral movements are prevented. Other advantages are secured by this arrangement, besides firmness; when the box needs cleaning or fumigation, the entire collection may be removed by taking out the frame; or camphor, tobacco, or other material can be placed on the bottom of the box, and concealed from sight. The annexed figure represents a transverse section of a portion of the side and bottom of the box with the frame. A, A, box. B, frame. P, P, upper and under sheets of paper. C, space between lower sheet of paper and bottom of the box.—E. S. MORSE.

Habits of the Carpenter Bees.—I send specimens in alcohol of the pupa of *Xylocopa virginica*, the Carpenter Bee, with the pupæ of *Anthrax sinuosa*. The latter fly I take to be a parasite of the Carpenter Bee. I found them occupying alternate cells or divisions in the mines of the Xylocopa. *Ceratina dupla*, a little green bee, allied to the Carpenter Bee, is now (May 18) busily boring and laying its eggs in almost every variety of pithy stems, such as the Elder and Syringa.—James Angus, *West Farms, N. Y.*

Parasites of the Humble Bee.—I have lately obtained four specimens of a moth, *Helia Americalis*, from a Bombus nest kept since last fall in a flower-pot, covered with a glass.—*Ib.*

GEOLOGY.

On the Absence of the Northern Drift formation from the western coast of North America, and from the interior of the continent.—Prof. Whitney made some remarks on the absence of the Northern Drift formation from the western coast of North America, and from the interior of the continent, throughout the region to the south-west of the Missouri River.

The term "Northern Drift" is understood to include the masses of unstratified detrital materials and boulders which have been transported and distributed by some general cause, independent in a great degree of the present conformation of the surface and of the direction of the existing river courses. The investigations of geologists have shown that the surface of Canada, New England, and the States north of the Ohio and north of the parallel of thirty-nine degrees, as far west as the Mississippi, and even for some distance beyond it in that direction, are covered by detrital materials which have been carried from the north towards the south, and often for a great distance and in immense masses.

The explorations of the Geological Survey of California have demonstrated, however, that there is no true Northern Drift within the limits of this State. Our detrital materials, which often form deposits of great extent and thickness, are invariably found to have been dependent for their origin and present position on causes similar to those now in action, and to have been deposited on the flanks and at the bases of the nearest mountain ranges by currents of water rushing down their slopes. While we have abundant evidence of the former existence of extensive glaciers in the Sierra Nevada, there is no reason to suppose that this ice was, to any extent, an effective agent in the transportation of the superficial detritus now resting on the flanks of the mountains. The glaciers were confined to the most elevated por-

tions of the mountains, and although the moraines which they have left as evidence of their former extension are often large and conspicuous, they are insignificant in comparison with the detrital masses formed by aqueous erosion. There is nothing anywhere in California which indicates a general glacial epoch during which ice covered the whole country and moved bodies of detritus over the surface, independently of its present configuration, as is seen throughout the North-eastern States.

The same condition of things prevails in Nevada and through Oregon, as far as explored by the members of the Survey. The detritus seems always to be accumulated at the base of the mountains — gravel, boulders, and sand lying below and not far distant from the bed of rock of which these materials once formed a part, and from which they appear to have been detached by weathering and aqueous erosion.

From the observations of Messrs. Ashburner and Dall, it would appear that no evidences of Northern Drift have yet been detected on this coast, even as far north as British Columbia or Russian America. Neither of these gentlemen have observed any indication of a transportation of drift materials from the north towards the south, or of any condition of things similar to that which must have existed in the Eastern States during the diluvial epoch.—*Proceedings of the California Academy of Natural Sciences.* 1866. Vol 3, part iii.

MICROSCOPY.

Test Objects for the Microscope.—To such wonderful perfection has this process been carried, that M. Nobert, of Griefswald, in Prussia, has engraved lines upon glass so close together, that upwards of eighty thousand would go in the space of an English inch. Several series of these lines were engraved upon one slip of glass. By these the defining power of any object-glass could be ascertained. As test objects, they are equal to, and even rival, many natural objects which have hitherto been employed for this purpose. The delicate lines on some of the diatomaceæ are separated from each other by the 1-50,000th of an inch, while the finest lines engraved by M. Nobert are not more than the 1-100,000th of an inch apart.

The Podura scale is a most excellent "test object." According to Prof. J. W. Bailey, the diatoms *Grammatophora subtillissima* and *Hyalodiscus subtilis* are the most delicate tests. — Beale.

Diatoms. — These beautiful objects for the microscope are minute silicious plants, which from their ability to move about independently in the water, and from being supposed to have stomachs, were for a long while thought to be animals, and placed among the Infusoria.

Their hard silicious shells are characterized by being marked with fine delicate lines or rows of dots. They are found in all our waters, whether salt, brackish, or fresh. Their hard shells are preserved under bogs, where they form layers, resembling fine white silicious sand, and also in guano. They also occur fossil at Bermuda, Oran in Algeria, and Richmond, Va.

OBJECT TEACHING IN NATURAL SCIENCE.—I am strongly of opinion that it is more necessary than ever that we should teach as much as possible by the eye. In teaching any branch of natural science, the *demonstration* should be combined with *oral* teaching. The student should *see* what is described, and where it is not possible for the teacher to exhibit illustrative specimens, good models, drawings, and explanatory diagrams should be supplied. It is the duty of every teacher to study how to communicate knowledge *most easily* and *most clearly*, and to save the student as much time as possible; for it is not likely that the amount of work which is required by the various examining boards will be reduced, nor indeed is it desirable that it should be. It is, therefore, incumbent upon teachers to facilitate the communication of knowledge in every possible way. A lecturer on every branch of microscopic inquiry can now show his pupils the structures he describes. For the last three years I have carried out this plan myself, and have found that it works admirably. I am able to demonstrate from eight to twelve microscopical specimens to a large class in the course of an hour, and it need scarcely be added, such a system adds greatly to the interest of lectures, and enables the student to acquire a correct idea of structure, which it is impossible for him to obtain by reading, or from mere description with the aid of diagrams.—BEALE'S "*How to Work with the Microscope.*"

SCIENTIFIC EXPEDITIONS.

Mr. C. F. Hartt, now lecturing on Natural History in New York City, who gained much experience as an explorer in Brazil, in the late Thayer Expedition to the Amazon, under the conduct of Prof. Agassiz, purposes in a few weeks to visit anew the coast of Brazil, and study the coral reefs previously discovered by him, and also the marine fauna of these shores. Mr. Hartt goes thoroughly prepared for these important researches, by his previous experience in exploring the Geology of Nova Scotia, while connected with the Provincial Geological Survey; and also as a student and assistant for several years in the Museum of Comparative Zoölogy, at Cambridge.

Mr. J. F. Allan, of Springfield, Mass., author of a series of ornithological papers now publishing in the NATURALIST, and also one of

Prof. Agassiz' party in Brazil, starts this month to explore western Iowa, both to collect and study the animals and fossils of that little-known region. If successful in this field, he intends to push on, another season, to the Rocky Mountains, and collect in that region.

CORRESPONDENCE.

G. H. K.—The most brief and comprehensive Manuals of Taxidermy, or the art of preparing specimens of Natural History for the cabinet, are those published by the Smithsonian Institution, Washington, D. C., in pamphlet form, especially the Directions for collecting, preserving, and transporting specimens of Natural History.

J. T. G., Massachusetts.—Among the best works from which to gain a general knowledge of Natural History are Prof. Asa Gray's Botanical Series, embracing the following:—

How Plants Grow.

First Lessons in Botany.

Manual of Botany of the United States. Illustrated. 8vo. Published by Messrs. Ivison & Phinney, New York.

Agassiz & Gould's Principles of Zoölogy. Gould & Lincoln, Boston.

Mind in Nature. By H. J. Clark. Appleton & Co., New York, 1866.

Tenney's Zoölogy for Schools. C. Scribner, New York.

Harris's Insects Injurious to Vegetation. Nichols & Noyes, Boston.

Westwood's Classification of Insects. London. 2 vols. 8vo.

Dana's Manual of Geology. T. Bliss & Co., Philadelphia. 8vo.

Hugh Miller's Popular Geology, and other works, published by Gould & Lincoln, Boston.

Prof. A. Guyot's Series on Physical Geography, with his Physical Maps. C. Scribner, New York. Earth and Man. Gould & Lincoln, Boston. 12mo.

NATURAL HISTORY CALENDAR.

Ornithological Calendar for May.—The first half of May witnesses the grand culmination of the vernal migration; more species arriving between May 1st and 20th than during the rest of Spring; and probably at no period in the year are our woods so densely populated as now, when countless numbers, on their way north, spend a few days with us in their passage. Few arrive after the 15th or 20th, though in some seasons there are many representatives of species, which breed farther north, remaining till the close of the month.

1st to 7th.—The Barn Swallow, Chimney Swift, Brown Thrush, Cat Bird, Towhee Bunting, or Chewink, Least Flycatcher, Warbling Vireo, Black and White Creeper, and Whippoorwill become common. The Eaves, or Cliff, and Bank Swallows, King Bird, Golden-crowned and Water Thrushes, the Black-throated Green, Prairie, Blue Yellow-backed and Nashville Warblers; the House Wren and Marsh Wrens (*Cistothorus palustris* and *C. stellaris*), and the Summer Yellow Bird, or Yellow Warbler, begin to appear.

7th to 14th.—All the preceding become abundant, while the Bobolink, Baltimore and Orchard Orioles, Rose-breasted Grosbeak, Scarlet Tanager, Night Hawk, Maryland Yellow-throat, Veery, or Wilson's Thrush; Redstart, the Spotted Canada, Black-capped, Black-burnian, Bay-breasted, Black-throated Blue, Chestnut-sided, and Cape May Warblers; the Black-billed and Yellow-billed Cuckoos; the Red-eyed, White-eyed, and Yellow-throated Vireos; the Indigo Bird, Swainson's Thrush; the Acadian, Great-crested, Traill's, and Olive-sided Flycatchers; Henslow's Bunting, Red-headed Woodpecker, and Humming Bird arrive. The Tree and White-throated Sparrows, Hermit Thrush, and Ruby-crowned Kinglet retire northwards, or to the mountainous districts.

14th to 21st.—Wood Pewee, Yellow-breasted Chat, and Black Poll Warbler arrive. The woods and thickets, as well as the orchards and shrubbery of the garden, swarm with *Dendroicæ* or Wood Warblers, and with other species of *Sylvicolidæ* and Flycatchers.

21st to 31st.—Towards the close of the month, the various species of Warblers and their allies, that pass farther north to breed, retire thither and to the highlands. The Black Poll Warbler and Swainson's Thrush are (a few stragglers of other species still remaining) the only birds which remain in numbers, that pass north of central New England to breed.

All the summer visitors and vernal passengers have now arrived. Many of the early breeders, as the Blue Bird, Pewee, Robin, Song and Field Sparrows, etc., have, at the close of the month, nearly full-fledged young; occasionally the first brood takes wing. Others, as the Chewink, Cat Bird, Yellow-winged Sparrow, Red-winged Blackbird, Meadow Lark, Brown Thrush, Blue Jay, Chickadee, Swallows, Whippoorwill, etc., have commenced incubation; the Bobolink, Baltimore, Warbling, and other Vireos, and several Flycatchers and Warblers, have either begun building, or are pairing and selecting nest sites. In short, with one or two exceptions, all the birds have ceased roving, and choosing their summer homes, have entered upon the important duties attending the reproductive season.—J. A. A.

THE INSECTS OF MAY.—During this month there is great activity among the insects. As the flowers bloom and the leaves appear, multitudes wake from their long winter sleep, and during this month pass through the remainder of their transformations, and prepare for the summer campaign. Most insects hybernate in the chrysalis, or pupa, state, while many winter in the caterpillar or larva state, such as the larvæ of several Noctuidæ and the "yellow-bear," and other caterpillars of Arctia and its allies; while many insects hybernate in the adult or imago form, either as beetles, butterflies, or certain species of bees.

It is well known that the Queen Humble Bee winters under the moss, or in her old nest. During the present month her rovings seem to have a more definite object, and she seeks some deserted mouse-nest, or hollow in a tree or stump, and there stows away her pellets of pollen, containing two or three eggs apiece, which, late in the summer, are to form the nucleus of a well-appointed colony. The Carpenter Bees, Ceratina and Xylocopa, the latter of which is found in abundance south of New England, is busy in refitting and tunnelling out the hollows of the grape; while the Ceratina hollows out the stem of the elder, or blackberry. This little upholsterer bee carpets her honey-tight apartment, storing it with food for her young, and later in the season, in June, several of these cartridge-like cells, whose silken walls resemble the finest and most delicate parchment, may be found in the hollow stems of these plants.* The Mason Bee (*Osmia*) places her nest in a more exposed site, building her earthen cells of pellets of moistened mud, either situated under a stone, or in some more sheltered place, for instance in a deserted oak-gall, ranging half a dozen of them side by side along the vault of this strange domicile. Meanwhile their more lowly relatives, the Andrena and Halictus bees, are engaged in tunnelling the side of some sunny bank or path, running long galleries underground, sometimes for a foot or more, at the farthest end of which are to be found, in summer, little earthen urn-like cells, in which the grubs live upon the pollen stored up for them in little balls of the size of a pea. Later in the month, the Gall Flies (*Cynips*), those physiological puzzles, sting the leaves of our oaks, maples, and other trees, giving rise to the strange excrescences and multiform deformities which deface the stems and leaves of our most beautiful forest trees.

Fig 1.

The Coddling Moth. From HARRIS.

We spoke in our last number of the Coddling Moth, of which fruit-growers need to be forewarned, and here give a figure of the moth, so that it cannot be mistaken.

* We are indebted to Mr. James Angus for the facts regarding the habits of Hylocopa and Ceratina. The cells of *Osmia simillima* Smith, have been found as above described by Mr. F. G. Sanborn.

When the Kalmia, Rhodora, and wild Cherries are in bloom, many of our most beautiful butterflies appear; such are the different species of Lycæna, Thecla, and Argynnis. At this time we have found the rare larva of Melitæa Phæton, clothed in the richest red and velvety black, feeding daintily upon the Hazel Nut, and tender leaves of the Golden Rod. In June, it changes to the chrysalis state, and early in July the butterfly rises from the cold damp bogs, where we have oftenest found it, clad in its rich dress.

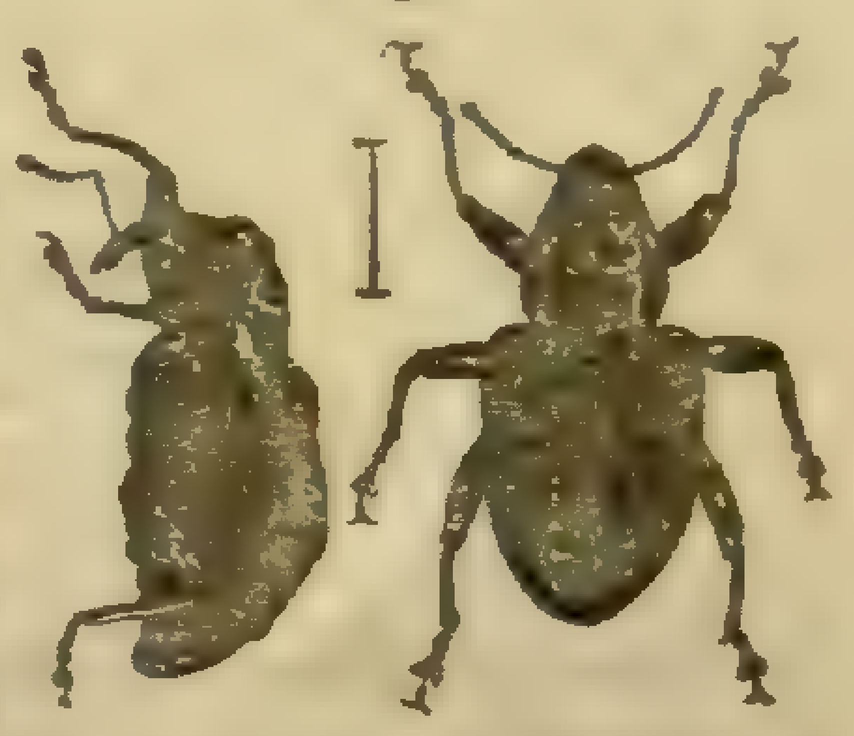
Later still, when the Lilac blooms, and farther south the broad-leaved Kalmia, the gaily-colored Humming Bird Moth (*Sesia*), visits the flowers in company with the Swallow-tail Butterfly (*Papilio Turnus*). At twilight, the Hawk-moth, Sphinx, darts noiselessly through our gardens, as soon as the Honeysuckles and Pinks and Lilies are in blossom.

Among the Flies (*Diptera*), Mosquitoes now appear, though they have not yet perhaps strayed far from their native swamps and fens; and their mammoth allies, the Daddy-long-legs (*Tipula*), rise from the fields and mould of our gardens in great numbers.

Of the Beetles (*Coleoptera*), those which feed on leaves now become specially active. The Squash Beetle (*Phyllobrothica vittata*, fig. 2) now attacks the Squash plants before they are fairly up; and the Plumb Weevil (*Conotrachelus nenuphar*, fig. 3. From Harris) will sting the newly-formed fruit, late in the month, or early in June. Many other Weevils now abound, stinging the seeds and fruit, and depositing their eggs just under the skin. So immense are the numbers of insects which fill the air and enliven the fields and woodlands, just as summer comes in, that a bare enumeration of them would overcrowd our pages, and tire the reader.

Fig. 2.

Fig. 3.



A word, however, about our Water Insects. Late in the month the May-fly (*Ephemera*) appears, often rising, in immense numbers, from the surface of pools and sluggish brooks. In Europe, whole clouds of these delicate forms, with their thin white wings, have been known to fall like snow upon the ground, when the peasants gather them up in heaps to enrich their gardens and farms.

The Case Worms, or Caddis Flies, begin now to leave their portable houses, formed of pieces of leaves, or sticks and fine gravel, and fly over the water, resting on the overhanging trees.

A few busy Mosquito Hawks, or Dragon Flies (*Libellula*), herald the coming of the summer brood of these indefatigable friends of the Agriculturist. During their whole life below the waters, these entomo-

logical Herods have slain and sucked the blood of myriads of infant mosquitoes and other insects; and now, in their new world above the waters, with still more intensified powers of doing mischief, happily, however, to flies mostly obnoxious to man, they riot in bloodshed and carnage.

This is the season to stock the fresh-water aquarium. Go to the nearest brook, gather a sprig or two of the Water Cress, which spreads so rapidly, a root of the Eel Grass, and plant them in a glass dish or deep jar. Pour in your water, let the sand and sediment settle, and then put in a few Tadpoles, a Newt (Salamander), Snails, (*Limnea*, *Planorbis*, and *Valvata*), Caddis Flies, and Water Beetles, together with the gatherings from a thicket of Eel Grass, or other submerged plants, being rich in the young of various flies, Ephemeras, Dragon-flies, and Water-fleas (*Entomostraca*), which last are beautiful objects for the microscope, and in a few days the occupants will "feel at home," and the aquarium will be swarming with life, affording amusement and occupation for many a dull hour, by day or at night, in watching the marvels of insect transformations, and plant-growth.—A. S. P.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Boston Society of Natural History. *January* 16. Concluded. —Mr. W. W. Bailey read a paper on *Epigæa repens*, the May flower, by Prof. L. W. Bailey, of Fredericton, N. B., in which he mentions finding specimens exhibiting the following peculiarities: Corolla, imperfectly salverform (the petals not thoroughly coherent into a tube, which were not hairy), and apparently not *deciduous*; the stamens reverted into specimens of the ordinary kind more or less united. Some of these showing a transitional form, in having a filament-like base, but no anthers. The pistils were indistinct, and had reverted into petals.

Feb. 6, 1867.—The Secretary read a paper by Dr. S. Kneeland, on a fungoid Parasite, or Caterpillar Fungus, from the Philippine Islands, to which were appended some remarks of Mr. C. J. Sprague, on the probable botanical relations of this fungus.

Dr. J. C. White exhibited, under the microscope, living young of the Guinea, or thread-worm (Filaria Medinensis). He described the form and mode of development of the parent animal, and spoke of what was known of their habits, and their mode of effecting an entrance into the human body during bathing in places where they occurred.

Mr. W. T. Brigham stated that it was generally believed near Cal-

cutta, that a certain species of fish destroyed this worm, and only those who bathed in tanks unstocked with this fish were troubled by them.

Mr. W. Winwood Reade said, that in Africa they were much more common in Guinea proper, than on any other part of the coast; it was there generally believed to be prevalent on account of the impurity of the drinking water.

Mr. Theodore Lyman remarked on the laws of breeding Shad and Salmon, the gradual extirpation of these fish from our rivers by the erection of dams, and exhibited models of fish-ways which had recently been constructed on the Merrimac, under the direction of the State Commissioners.

Mr. F. W. Putnam, after announcing the donation of two species of fish from Lake Winnipisiogee, one the *Lota maculosa* (Ling, or fresh-water Cusk), and the other a species of Lake Trout, probably the *Salmo confinis* of De Kay, remarked that it seemed to him a matter of doubt whether many of our Lake Trout are anything more than forms of the Brook Trout. Referring also to Mr. Lyman's remarks on the habits of the Salmon, Mr. Putnam stated that Dr. Bernard Gilpin, of Nova Scotia, had recently been making observations upon the male Salmon, and had discovered that it must have three sets of teeth formed one after the other; that one set falls out just before ascending the river, when the cartilaginous enlargement of the jaws takes place; that a new set grows out during the ascent of the stream, which is destroyed during its contests with others of its sex, and by excavating hollows in the gravel for the eggs; in this condition it returns to the sea, where it again attains a new and normal set of teeth.

Section of Microscopy. Feb. 13, 1867.—Mr. Charles Stodder read a paper on the fungus found on insects, and showed four preparations which he had made for examination. Mr. Stodder also read a paper upon a recent gathering of Diatomaceous mud, from Pleasant Beach, Cohasset.

Dr. B. J. Jeffries exhibited some glasses and metallic mirrors used in examination of diseases of the eye. He made remarks upon the use of colored glasses (blue), the mode of coloring, and the advantage of this particular color (cobalt blue) over green or grey in relieving the eye from the effects of sunlight.

Essex Institute, *Salem, February* 4.—Mr. F. W. Putnam exhibited a singular specimen of the Horned Pout (*Pimelodus atrarius* De Kay) from Lake Champlain, presented by Dr. B. Pickman, of Boston. The fish was pure white, thus showing that albinos occur among fishes as well as in the birds and mammals, though this was the first instance of albinism known to him as occurring in this class.

THE LYCEUM OF NATURAL HISTORY OF NEW YORK.—At the annual meeting of the Lyceum of Natural History, held in Clinton Hall on Monday night, Feb. 25, the following officers were elected: President, Prof. Charles A. Joy (of Columbia College); First Vice-President, Prof. J. S. Newberry; Second Vice-President, Gen. Livingston Satterlee; Corresponding Secretary, Robert Dinwiddie; Recording Secretary, Robert H. Browne; Treasurer, Temple Prime; Curators, S. C. H. Bailey, Geo. N. Lawrence, Dr. Richard P. Stevens, George Suckley, M. D.; Librarian, Oran W. Morris.

This Society was founded in 1818, by Dr. Mitchell, Dr. Torrey, Mr. Cooper, and a few students of science. The early records of their meetings contain amusing accounts of the explorations made by the members to remote parts of the Island of New York, and of their adventures among the swamps and brambles of Pearl and Canal streets, Some of the more enterprising members sought for minerals in the regions of Central Park, and the analyses were published in Bruce's Mineralogical Journal. De Witt Clinton was a contributor to the Annals of the Lyceum, and Audubon, De Kay, Lucien Bonaparte, Cooper, Dana, Torrey, Le Conte, and Thomson were among the early writers who sent communications to the Society. There have only been three Presidents during the fifty years of the existence of the Lyceum, Dr. Mitchell, Dr. Torrey, and Major Delafield. The latter declined a reelection, and the honor now devolves upon a younger generation. It is proposed to celebrate the fiftieth anniversary next year, and, in view of the fact that the Society has no hall of its own, an effort will be made to raise $100,000 for the purpose of securing suitable accommodations.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.—The Sixteenth Annual Meeting will be held at Burlington, Vermont. The Session begins on Wednesday, August 21st, 1867, at 10 o'clock, A. M.

"The last meeting of the Association at Buffalo, N. Y., continued for a week, and was considered a pleasant and successful renewal of the yearly conventions of the Association. About ninety old members were in attendance, one hundred and twelve new members were elected, and sixty-nine papers were presented and read.

"Fears lest the cholera might prevent the Meeting at Buffalo, as it did at Cleveland for one year, caused the circular to be delayed until after many members of the Association had left their homes for the summer, or had made other arrangements inconsistent with a journey to Buffalo. On this account the meeting was not so well attended as on some other occasions. The previous meeting at Newport, R. I., had also been small. As the assessments are collected, in large part, at the meetings, the funds of the Association have suffered from two

meetings, more thinly attended than the average, following each other in immediate succession. It will be impossible to print the usual volume of Proceedings, unless the funds are largely augmented: the expense of paper and printing having greatly increased, while the collections have diminished. If the arrears now due to the Association are promptly paid, the Publications can proceed as usual, and the Association stand on an independent basis."—JOSEPH LOVERING, *Permanent Secretary, Cambridge, Mass.*

AMERICAN MICROSCOPICAL SOCIETY. *New York, January* 26, 1867. —Mr. A. M. Edwards read a paper entitled "Note on the relations of Monochromatic Light to Microscopical Observations," calling attention again to the fact of his having some time back brought before this Society a theory of his, of the relation of active illumination to vision, and the definition of objects seen through lenses; at the same time detailing some recent investigations made by others, which he considered to confirm his theory. He then proceeded to illustrate his subject by using the colored plates in Chevereul's book on the applications of colors to the industrial arts, illuminating them by the Sodium flame, gas-light, and the light of burning magnesium successively. He remarked how careful observers should be in drawing conclusions from what they think they see by means of the microscope.

Mr. J. E. Gavit detailed two cases in which he had been called upon to use the microscope for the purpose of deciding points in which large sums of money were involved. The first was to decide which of two writings crossing each other—one in black ink, the other in red—was the most recent. With a microscope, he was able to demonstrate, to the perfect satisfaction of the parties interested, which was written last. The second case was to decide if a name written to the codicil of a will was a forgery or not, and described the manner in which he had used a microscope to determine that point.

Mr. Edwards spoke of some discoveries of Prof. H. L. Smith, who thought he had seen the formation of an Amœba from the contents of a Pinnularia, and the after formation of an Actinophrys from that Amœba.

ENTOMOLOGICAL SOCIETY OF CANADA, *Quebec Branch. Annual Meeting, Jan.* 9, 1867.—After the Address of the President, the Secretary read the Third Annual Report of the Council.

A paper on a Parasite infesting the Trout, was read by Mr. William Couper, of Quebec.

This Society has also a Branch Society at London and Toronto, C. W.

ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA. *Feb.* 19.—The following papers were presented:—

A list of introduced Plants, mostly Southern, growing in the waste ground below Philadelphia Navy Yard, and at Kaighri's Point and Petty's Island, on the opposite shore of the Delaware, in 1864, 1865, and 1866, by Aubrey H. Smith.

On the Habits of the Cutting Ant of Texas, by G. Lincecum, M. D.

A letter was read from C. M. Wetherill, Bethlehem, Pa., regarding the Structure of Hacolumites.

A communication was received from the Recorder of the Conchological Section, announcing their organization and the election of officers.

March 5.—Prof. Leeds remarked on the Magnesium Light. Prof. Hayden exhibited some field sketches of the far West. Prof. Ennis spoke on the origin of the Stars, the causes of their motions, and their light.

ENTOMOLOGICAL SOCIETY OF PHILADELPHIA.—At a meeting held March 11, 1867, the following By-Law was unanimously adopted:—

"Article 1, Chapter 1.—The Society shall be called the AMERICAN ENTOMOLOGICAL SOCIETY, and is instituted for the improvement and advancement of Entomological Science, and the investigation of the character and habits of Insects."

The above change has been made for two reasons. 1st. That the Society has to rely on the country at large for support, and in order to receive this support, the erroneous idea which is in many minds, namely, that the Society is a *local* institution, must be displaced. 2d. It is believed that this change in the name will extend the reputation and claims of the Society, and awaken new and more extended exertions for the permanent support of the only Entomological Society in the United States.

THE YORK INSTITUTE OF SACO, MAINE.—This Society, recently organized for the promotion of the Natural Sciences and History, are adding new members to their ranks, and from the proceeds of a course of lectures, have furnished their room with cases in which to display their collection.

PORTLAND SOCIETY OF NATURAL HISTORY.—We are glad to learn that this Society, despite their unprecedented misfortunes in losing for the second time their entire collections by fire, are about to resume their publications by completing the first volume of their "Proceedings." The first part was published several years since. The second part, now to be published, will contain seventy-two pages.

THE

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THE RECENT BIRD TRACKS OF THE BASIN OF MINAS.

BY C. FRED. HARTT, A. M.

Almost in the very heart of Nova Scotia is the Basin of Minas, a beautiful sheet of water communicating with the head of the Bay of Fundy by a narrow strait. It is triangular in shape, the longer, or northern shore being about sixty miles in length, running nearly east and west, skirting the Cobequid hills. The western or shortest side runs about north and south, along the edge of the fertile New-Red Sandstone district of Cornwallis, known as the "Garden of Nova Scotia," or "Corn-and-potatoes-wallis." At the southern angle of the triangle enter two rivers, or, more properly, estuaries; the Cornwallis, which comes from the west, and the Avon, which enters from the south-east. Between the mouth of these two rivers is the Grand Pré, the home of Evangeline, rendered celebrated by the delightful poem of Longfellow.

The scenery of this part of Nova Scotia is very picturesque and beautiful. Almost at the mouth of the Cornwallis is the pretty little village of Wolfville, the seat of Acadia College. From the cupola of that Institution we

Entered according to Act of Congress, in the year 1867, by the Essex Institute, in the Clerk's Office of the District Court of the District of Massachusetts.

look over nearly the whole Basin and the surrounding country. In front of us is the Basin; to the left, somewhat, Cornwallis, with its low, undulating lands dotted with farms and farm-houses, and beyond, the North mountains that border the whole southern shore of the Bay of Fundy like a wall, breaking down abruptly on the western shore of the Basin of Minas, forming a noble promontory, Cape Blomidon, whose bright red sandstone cliffs and frowning trap-crags are not less grand than the Palisades of the Hudson. We see the high ridge of the Cobequids stretching along the northern shore eastward as far as the eye can reach, while just east of the Avon are the Carboniferous hills of Cheverie, and on our right and almost at our very feet is the Grand Pré.

At Halifax, and along the Atlantic shore of Nova Scotia, the tide rises but a few feet; but, as every one knows, the rise at the head of the Bay of Fundy amounts sometimes to seventy feet.

Arriving at Halifax by steamer, we take the cars to Windsor, a little town on the Avon, a few miles above its mouth, whence a small steamer plies to St. John, New Brunswick. We arrive two or three hours before the steamer is expected in. There is a crowd on the wharf, and we go down to see what is the matter, but to our astonishment we see a wide, deep valley, like a great mud ditch, and no water, except a narrow stream, excessively turbid, which meanders over the expanse of soft chocolate-colored mud and sand at the bottom. At the foot of the wharf, which is some twenty or more feet high, a bank of soft mud, scored with trough-like depressions made by the keels of vessels, slopes off ten feet further to the bed of the river. Vessels lie high and dry at the wharves, and—Where is the water?

Below Windsor, one looks down the river some distance, and then the view is shut off by an eastward bend. By and by we see something white making its appearance at this point. It is advancing up the stream, and there is a gleam of water behind it. Some one who has also been on the lookout exclaims, "Here comes the tide!" We see it coming steadily up the channels, with a line of foam* along its front. It rushes swiftly by us, passes under the long bridge that spans the Avon just above the town, and is out of sight. Meanwhile the whole bottom of the depression is flooded, and the water is pouring in like a river. It creeps visibly up the edges of the mud banks, gains the bases of the piers, and sweeps out higher and yet higher the sun-dried, muddy fronds of the coarse, knotty-leaved fuci, that hang heavily from the pier. As we watch the flood eddying and rippling along the sides of the wharves, gaining steadily and visibly in height every moment, we can scarcely repress the question, Where will it stop? But a little while ago we looked down the river and saw it as a great empty mud ditch. Now it is a broad expanse of water, that would be beautiful, were it not that its waves are excessively turbid, and of a coffee, or rather chocolate, color, contrasting strangely with the green meadows and cultivated hillsides that border it. There is a little fleet of vessels too, that is being borne in on the current, and presently some one cries out, "Here she comes!" There is a long black line of smoke issuing from beyond the elms on the point, and in a moment the little bay steamer makes her appearance, and is soon blowing off steam alongside of the pier. Meanwhile the tide has risen so as nearly to fill

*The shape of the estuary of the Peticodiac, in New Brunswick, is such as to cause the formation of a "bore," or high wave, that sweeps violently up the channel in its narrow part in advance of the tide.

the channel. An hour afterwards, when the boat leaves, the marsh meadows are overflowed, and all the bordering flat lands would be deluged, were they not protected from the flood by a line of embankments, called "dykes." Away goes the steamer with the turn of the tide, a few little vessels drop down on its current, and five hours afterwards little boys wade across in the mud above the bridge to avoid paying the toll.

The northern and southern shores of the Basin of Minas are bordered by bluffs of Lower Carboniferous sandstone and shale, and soft, bright-red beds of clayey sandstone belonging to the "New-Red" or Trias formation of geologists. The western shore is wholly composed of this latter rock.

One would expect that the action of tidal currents, such as we have described, combined with the amount of surface exposed to wave-action, between high and low water, would cause a great wear of the coast; and such is the case, both in the Bay of Fundy and the Basin of Minas. Frosts heave off every year great masses from the trap cliffs of Blomidon, or the shale and sandstone bluffs of the coast of the Basin, and every year sees them more or less completely removed, by the joint action of currents and floating ice. The wear and tear of the softer rocks furnishes a copious fine red mud, which is distributed by the currents over the whole bay.* During the intervals between ebb and flow, when the waters are stationary, this sediment that is deposited forms extensive banks, exposed over large tracts along the shores at low tide. Each tide adds its layer to these banks and sloping shores, sometimes but an exceedingly thin film, at others, espec-

* This mud is also borne by the Bay of Fundy current along the coast of Maine even, as we have been informed by fishermen, as far as the mouth of the Kennebec River.—EDITORS.

ially after stormy weather, amounting to a quarter of an inch or more. The layer formed by a night tide is said to be thicker than that deposited by a day tide. The mud banks, as well as the flat marsh-lands bordering the Basin, especially in Horton and Cornwallis, are composed of this material. Where large tracts had reached such a height as to be covered by only a few feet of water at high tide, the inhabitants, to whom the French Acadians set the example, have dyked them in, and as the "marsh mud" forms a very fertile soil, these dyked lands are very valuable. A little island lay a couple of miles from the southern shore of the bay, between the mouth of the Avon and Cornwallis. Mud accumulated between it and the main land, and as the deposits increased, it at last formed a marsh joining the island to the shore. The French Acadians dyked this in, and the great meadow thus formed was the Grand Pré, where Basil toiled in the forge and paid court to Evangeline.

It is a beautiful day in June: let us pay a visit to the Cornwallis River, near Wolfville. The dyked land here, planted with oats and grass, potatoes, etc., is but a narrow strip bordering the river. We cross it, observing the regularly laid-out ditches used to collect the surface water, and carry it off by sluices through the dykes, which is merely a mud wall a few feet in height, sufficient to keep out the waves at high tide. Outside this wall we find a flat area, in part bare and muddy, partly sedge-covered. Deep gullies are cut in it by the water as it is drained off, and at their bottoms we see immense numbers of coarse black-looking little shells (*Nassa obsoleta* Say) crawling about. We find also a great many specimens of a kind of mussel, with a furrowed shell (*Modiola plicatula* Lamk.), half buried in the mud. Occasionally a

clam shell turns up (*Mya arenaria* Linn.), and perhaps a little thin round and flat shell (*Macoma fusca* Say), while a little univalve shell (*Littorina rudis* Mont.) is not uncommonly found attached to the blades of sedge. "Fudge!" says our companion, looking at his but half-visible boots, "we might have chosen a better locality for an excursion than this. Let's go back for a ramble among the hills." "Not so fast, my friend, we've come down here to take a lesson from Nature, and we'll find something interesting by and by." By dint of wading through the mud, leaping across ditches, an exploit rendered somewhat difficult owing to the tenacity of the mud, which makes jumping out of one's boots something easy to accomplish, we reach a sedgy tract, and this crossed, we are by the side of the river. The tide is out, and a scene like that we witnessed on the Avon, at Windsor, meets the eye. The bank slopes rather steeply from its top to the bed of the river. The warm sun has dried and cracked the mud on the surface along the upper edge of the bank, and it is divided into polygonal pieces by a network of cracks, like that of a dried up mud-puddle, and the upper layers are curled up a little so as to be partially separated from those underneath. This cracked and dried part forms a zone running along the whole bank, and extending downwards some distance below high tide mark. In the lower part the bank is always soft. Crack! goes a gun. We look around and see a sportsman not far off, the blue wreath of smoke from his piece fast drifting over the dyke, while an immense flock of "Marsh Peeps" (*Tringa minuta*), is whirling around him, now almost invisible, now flashing up like a cloud of snow-flakes, as they take a different tack, exposing their white breasts. In certain seasons of the year this little bird is very numerous on this shore,

together with several other species of waders, and large flocks of them may be seen running busily about over the mud flats, searching for worms, crustaceans, etc.

The baked mud of the upper zone is at present too hard to retain the impressions of their footsteps, while that near the bottom of the slope is too soft. The middle zone, with its smooth, glossy, partially dried surface, is eminently fitted to receive and retain the most delicate impressions, and it is covered all over with the long zig-zag lines of their little three-toed tracks. We distinguish readily the tracks of other species of birds that have run over the same surface. Here is the large three-toed impression of the foot of the Great Blue Heron, which we frightened away when we came up, and which is now wading about leisurely along the edge of a sand-bank in the middle of the river. Here are also tracks of crows and dogs, and here, the deep, brokenly-cut hoof-prints of a cow. There are tracks both of booted and barefooted gunners. See! these impressions were made by a person walking leisurely, but if you will follow them on a little you will find that they begin to be suddenly farther apart, and the toe becomes more deeply impressed. A sportsman has stolen quietly up to a flock of "Peeps," fired, and then run to pick up his game. Here we find great numbers of tracks made by the flock into which he fired; and we see, also, the long grooves made by the shot. There are feathers lying about, and we can tell from the different directions in which he ran, that he has shot and picked up half a dozen birds.

Let us now go up the slope a little further, to where the mud is dry and cracked. On this hardened surface we find the tracks of birds that ran over it a couple of hours ago, when it was still soft. We scale off a few

pieces of the upper layer to carry away with us as a specimen, and in doing so discover that there are tracks of the same kind on the next layer underneath. On a previous day the birds ran about over the mud as to-day, leaving the impressions of their feet; these hardened in the sun; the tide came up softly and flowed over them, depositing a new layer of mud upon them, thus preserving them. This layer is pitted with little pear-shaped impressions. "Why! these must be rain prints," suggests our companion, who has begun to be interested in mud-studies, "and the storm must have come from the west too, because the prints are not round but pear-shaped, and from the direction in which the small end of the impression is turned, you can see whence the wind was blowing at the time; besides, the shower could not have lasted long else it would have made the mud too soft, and none of the prints would have been preserved. By the bye, we had a slight shower this morning, just a little while after the tide was full. I'll venture that near high tide mark we shall find some record of it. Yes! here they are, and these, too, are not round, for you remember that there was a smart breeze blowing at the time, and so the drops struck slantingly, making oblong impressions, the smaller ends of which are directed to the point of the compass from which the wind blew." Shells, bones of fish and other animals become buried in these beds, together with the remains of plants, leaves of trees, pine cones, or other fruits; but it is an exceedingly rare thing to find on these flats a dead bird, unless it is one which has been killed by a sportsman.—*Concluded in next number.*

THE HABITS OF THE GORILLA.

BY W. WINWOOD READE.

New England has the honor of having discovered this celebrated ape. The first specimen was brought to Boston by Dr. Savage. It was discovered by Professor Jeffries Wyman, and named by him after the wild men (*gorillæ*) which Hanno mentions.

Professor Wyman, however, advanced no hypothesis as to their identity. It has recently been suggested, and even asserted, that the gorilla of Hanno, and the gorillas of the present day are the same. But that is a conjecture, not *impossible* indeed, but incapable of anything like proof.

Hanno, a Carthaginian, made an exploring voyage down the west coast of Africa. His log, or Periplus, has been preserved. He records the number of days occupied by his voyage, mentions its chief incidents, and describes the features of the coast sometimes with minuteness. The two great authorities upon the Periplus are Gosselin (*Geographie des Anciens*) and Rennell (*Geography of Herodotus*). The former, a sceptic, will not allow that Hanno sailed beyond the limits of the Barbary coast; an hypothesis to be rejected: while Rennell, evidently desirous of taking him as far as he can, fixes the end of his voyage at a little below Sierra Leone. Now the chimpanzee is found in that region; but the gorilla is found only close to the equator. In the first place, therefore, Hanno's voyage must be stretched to the equator.

Allowing that he did reach the equator, and that the volcanic peak of Fernando Po was the Currus Deorum, "the flames of which seemed to touch the sky," another

difficulty remains to be disposed of. He says that the gorillæ defended themselves with stones, and escaped over the precipices. Now there are no precipices on the coast of the gorilla country, and the gorilla of the nineteenth century is not in the habit of throwing stones.

The northern limit of its *habitat* I ascertained to be Cape St. John. I have not penetrated to its southern limit, but it is probably Loango. No good reason can be assigned why the gorilla should not be found wherever the chimpanzee is found; but specimens of the former have not yet been procured from the backwoods of Sierra Leone and Liberia, where the latter ape is met with frequently enough. How far east the gorilla country extends is of course unknown. The Fans are the most inland tribe at present known east of the Gaboon. They told me that in the distant country to the north-east whence they came, the gorilla (*ngi*) was more common than in the Gaboon; so common that they could sometimes hear his cry from their towns.

The gorilla moves from place to place, but is almost always found in the thickest part of the virgin forest. His migrations, if they can be so called, are probably determined by the food seasons. He is very partial to one or two kinds of fruit. I was also shown a kind of grass growing in small tufts; wherever that grass grows, the gorilla is found.

Waterton says that the *monkeys have no home.* This is certainly true of the gorilla and of the other anthropoid apes, and it is this which renders it so difficult to shoot them in a country which is one vast forest, with here and there a meadow or a marsh. The gorilla builds a nest, it is true, but not as a residence. The male arranges this rude bed of boughs when the female is pregnant; she is

confined on it, and it is then deserted. Possibly a gorilla might be detected sleeping in one now and then, as birds often roost in old nests, but it is not made for that purpose.

The gorilla is partly terrestrial in its habits. It moves on all fours, sometimes assuming the erect position, but with difficulty, and only for a short time. As it goes along it breaks the branches of trees on either side; sometimes it ascends a tree to feed upon the fruit. The plantations of the natives are usually at some distance from their villages; the gorilla frequently visits them to eat the plantain and the sugar-cane, especially at morn and eve. At night it chooses a large tree to sleep in. Its ordinary cry is of a plaintive character; when enraged, it is a kind of bark, or short, abrupt roar. It does not attack man without provocation. When assailed or wounded, it charges on all fours, seizes the offensive object, bites it, and immediately retreats.

The gorilla is polygamous, and the male is frequently solitary; in fact, I have never seen more than one track at a time: but there is no doubt that both gorillas and chimpanzees are also found in bands. The males are said to fight with one another in the rutting season. The dung is like that of man, but notched in a peculiar manner. There appears to be little difference in the habits of the gorilla and the chimpanzee. The former ape is confined to a smaller area, at least as far as we know. The chimpanzee is said by the natives to be more intelligent, and less ferocious. They also, though feeding on the same kind of food, appear to prefer different sorts; for which reason it is, probably, that they are found in different localities.

I have seen one young gorilla in a state of captivity; it

was as docile as the young chimpanzee, which I also saw. It has been asserted, however, on good authority, that the young gorilla is sometimes perfectly untamable. All the authorities upon the habits of the gorilla are cited by Professor Huxley in his "Man's Place in Nature," with the exception of a curious passage in Monboddo's "Origin and Progress of Language" (vol. i. p. 281). M. Du Chaillu, in his "Journey to Ashango Land," also gives some details which are interesting, rather as tending to confirm what was previously known, than as throwing any new light upon the subject.

In fact, there is nothing remarkable in the habits of the gorilla, nothing which broadly distinguishes it from the other African apes, nor even from the ourang outang, which also builds a nest, which also assumes the erect posture now and then, and which also charges when wounded or brought to bay.

THE MOSS-ANIMALS, OR FRESH WATER POLYZOA.

PLATE 5.

BY ALPHEUS HYATT.

(Concluded from page 136.)

ALTHOUGH Fredericella has been more particularly referred to in the preceding Articles, they are, with one exception, almost equally applicable to all of the Phylactolæmata. This exception is the round disc, or lophophore, which in the other four genera changes to a horse shoe shape. (Compare Plate 3, fig. 4, with Plate 4, fig. 1.)

These four have, like the Fredericella, very euphonious names, Plumatella, Pectinatella, Lophopus, and Cristatella; and, while preserving a general identity, vary

extremely in the details of their anatomy and habits of life.

The Plumatellæ abound near the shores of our ponds, close to the surface, and are generally found with Fredericella. Better fitted, however, to endure the sun's rays, they sometimes seek places more exposed to their influence.

One sultry summer day, while searching for Polyzoa under the shelter of a bridge, my attention was drawn to the long water-grasses farther out in the stream, where, to my surprise, I found a specimen of Plumatella Arethusa, its tiny branches and living crystalline flowers glittering in the light as they swayed in the current unprotected from the heat.

The colony is like that of Fredericella, and in some species the unpractised eye would not detect the difference until the horseshoe-like discs were discovered. In others, however, such as Plumatella vitrea, the outer envelope remains gelatinous and transparent in the adult as in the young, and the tubes, or polypides, are in groups of two and more, counting sometimes twenty plumes.

The colony is dendritic, but the branches are always creepers along the surface, and there are no constrictions between the polypides, the branch being merely an elongated, undivided sac. It approximates, in this respect, to the next genus, Lophopus, and would belong to it, but that the statoblast has the plain, oval annulus of its compatriots among the Plumatellæ, which ranks it with them.

Lophopus has, also, lobiform branches, but they are supported in an erect posture by the ectocyst, a lump of clear jelly in which they are buried. The whole colony is very minute, the polypides are all gathered at the ends of the branches, and no longer occupy separate cells as in

Fredericella and most of the Plumatellæ. In the United States, Lophopus is very rare, only one specimen having been found in the Schuylkill River, near Philadelphia. In England, it is abundant upon the stems of floating duck-weed (*Lemna*) and other fresh-water plants.

My first introduction to Pectinatella and Cristatella took place some years since at Pennissewasse Pond, in Maine, one of the smallest of the liquid gems adorning that State.

Induced by the representations of a scientific friend, I visited the pond late in September, and its unexpected treasures kept me a willing loiterer for several succeeding weeks. The season was charming, full of haze and color, with an occasional leaf drifting through the still air, to remind one that the funeral cortege of the summer was passing down the year. Our way to the pond led us through a tortuous, shallow channel, studded with the blackened trunks of trees, the remains of a grove that had once overshadowed the spot where we now floated. I learned that earlier in the season this channel was much deeper, wholly submerging the shattered stumps, which were covered by luxuriant growths of Pectinatellæ, hanging over them like ivy over ruined towers. At this season, however, they were bare, the Polyzoa having sought the cooler depths of the pond.

Passing under a picturesque bridge, we entered the main lake, a long expanse with undulating shores, more like a river than a lake. One could readily imagine it winding on to the distant hills, closing the view to the northward, and the old logs which here and there lifted their sun-baked heads above the autumnal-tinted waters, half reclining with the current, added another river-like feature to the scene. We selected the oldest of these as most likely to furnish us with the objects of our search.

It was firmly imbedded, but when we finally succeeded in bringing the under side in view, the rich harvest of specimens amply rewarded our labors.

No marine or fresh-water animals of our northern climate excel the Pectinatellæ in beauty, or equal them in the tropical profusion with which they grow. The clusters, some as large as our heads, others broad and flat, were covered by hexagonal figures about an inch in diameter, traced by the plumed tubes of thousands of Polyzoa. Each hexagonal pattern, and there were hundreds in some settlements, was a separate colony. The deep, amber-color of the gelatine beneath shone through their central spaces, and each thread of the dense fringe surrounding them was stained with a tiny scarlet dot, the mouth of a polypide; the outline of one of these is given in Plate 4.

The cause of so many being assembled on one common deposit of jelly, is not the least curious fact in the history of the genus. A minute examination proves that a colony of Pectinatella is little more than a hollow case, distended by the fluids within, which prevent the soft walls from collapsing, and support the polypides protruding from the upper side in radiating lines. When this hollow case, or cœnœcium, attains the length of an inch, or an inch and a half, a crease shows itself as if a cord had been drawn tightly about the soft walls. This, deepening, finally cuts the colony into two smaller ones, and these, as they grow, divide into four, which in turn divide into sixteen, and so on. Where this increase is very rapid, the interior colonies are forced to expand upward, and, adding to the gelatine as they rise, build up, in some instances, clusters several feet in diameter, and eight or more inches in thickness.

Side by side with these, occurred thin patches of gelatine covered with what at first appeared a different species of Pectinatella. The central spaces of the colonies, however, were long and narrow, and much less brilliant, being surrounded by tawny-colored fringes of Polyzoa. This genus discards even the remnant of a branch which we mentioned in the lobes of the Pectinatella, and is a hollow sac flattened into a disc below, by which the whole colony move upon the gelatine or ectocyst as one animal.

In Fredericella, the hard, parchment-like condition of the ectocyst was owing wholly to the age of the colony; in the young, it was gelatinous.

We have seen, also, that Lophopus was buried in its own ectocyst, which remained gelatinous throughout life, and that the Pectinatellæ, though firmly attached, simply rested on theirs. And we now see Cristatella making the last step in this process, becoming entirely independent of its ectocyst, which is only a transient secretion thrown off from the creeping disc, like slime from the foot of a snail, to smooth the path over which it crawls. In large settlements the colonies lie closely together, but it is not infrequent to meet with a stray one wandering by itself. Locomotion is accomplished by a complete net-work of muscles within the sac. These, with perhaps other muscles in the walls, enable them to expand the disc in any direction, and then secreting gelatine, and holding to what they have thus gained, draw up their remaining portions. They move so slowly, however, that minute colonies require a day to get over an inch on the side of a smooth glass dish, the larger colonies progressing even more sluggishly. In Plate 5, the outline of a single polypide is given, with a portion of the net-work of internal muscles.

Cristatella is no exception in the animal kingdom; there are many instances in which compound animals move and act in unity. But here there is some hope of solving this mysterious diversity of number, with unity of will and purpose.

The nervous system, wherever it is present, whether in the distinct form of brain, nerve-mass, or ganglion, is essentially the medium of sensation and of motive power.

Now if the nervous system among the Polyzoa is a compound system, having a common trunk with branches leading off into each Polyzoön, a sensation in the main body could be conveyed to each individual, and thus the will of every minute tube be brought into harmony with all, causing the whole to move like one creature.

Fritz Müller, a German naturalist, has actually ascertained that in one of the marine species of Seriolaria, the nerves followed up the hollow trunk and branches of the colony like the dark wood in the heart of a tree, supplying each animal with a nerve. He noticed that if the trunk of the colony was irritated, that all the Polyzoa withdrew their plumes as if alarmed, and this led him to investigations, which resulted in such important discoveriės.

Whether all the polypides in a colony of Cristatella unanimously resolve to move, or whether the majority rule and drag the minority at will, or whether again the desire to move is excited in the central nerve-trunk by external causes, has not yet been determined.

One thing, however, seems probable, that the unanimity of action in the little republic is due to the union of the various individualized nervules into branches, and finally into one grand trunk, otherwise parts of the movable sac might be travelling in opposite directions at the

same time, from the sides as well as from the ends, and the colony be broad and sedentary, instead of long, narrow, and progressive.

EXPLANATION OF PLATE 5. *Cristatella ophidioidea* Hyatt.

Fig. 1. Magnified view of one Polypide, isolated, showing at E (above) the upper surface of the sac, or cœnœcium, and at E (below) the creeping disc, and at Q, Q, the meshes of the internal muscles, which aid in locomotion. M, M′, M″, muscles which retract the tube and plume, retractors. N, muscles which retain the fold, which is reduced in this genus to a circular constriction, and devoid of the muscles marked N′, in preceding plates. Ż, clear spaces in the wall of the arm. O, the bases of muscles which move the tentacles; the upper portions of these are seen in Fig. 7.

Figs. 2, 3, and 4. Upper and lower side, and profile view of the statoblast. W′, horny sheath; W″, annular sheath; W‴, spines, only eight and five pairs of these are figured, there are in nature twenty-two short and thirty-two long spines.

Fig. 5. View of intestine with upper part of stomach and lower part of throat in the background. K, throat; K′, stomach; K″, intestine; $\overline{K}$, anus.

THE LAND SNAILS OF NEW ENGLAND.

BY EDWARD S. MORSE.

(Continued from page 151.)

HELIX HORTENSIS *Muller.* (Fig. 16.) Shell nearly globular, smooth, shining, yellow. Whorls five, convex, spire somewhat elevated, suture at extremity of last whorl curved toward the aperture. Lip slightly reflected, white, and having a thickened margin within the shell; the reflected condition of the lip disappearing at the base of the shell. Aperture rounded; umbilicus absent. The base of the shell is quite convex. Specimens are sometimes found with one or more brown bands revolving with the whorls. Animal blackish, tinged with brown; creeping disc inky; extremity dirty flesh-color.

Fig. 16.

HYATT ON THE MOSS ANIMALS.

This species has been found in the greatest abundance on certain islands on the coast of Maine, and also on the lower parts of Cape Cod and Cape Ann, as well as in Canada and Nova Scotia. It is unquestionably identical with the European species, and is supposed to have found its way to this country through commercial intercourse, though it seems strange that, while in the old country it is found near the habitations of men, in this country it occurs only upon the most uninhabitable islands.

In England, this species is very abundant, and forms a favorite food for the thrushes and blackbirds. Ralph Tate, the author of a very readable book on the land and fresh-water mollusks of Great Britain, says: "In a country walk one may frequently see a large stone surrounded by fractured snail-shells; these are the slaughtering-blocks whereon the poor snail is sacrificed for the welfare of our songsters and their young progenies. The shells are very systematically broken. The bird strikes the shell upon the stone in such a position as to expose the principal mass of the snail at about the commencement of the last whorl." In France, this species is used as an article of food.

Figs. 17, 18.

Helix alternata *Say*. (Figs. 17, 18.) Shell flattened, heavily striated; light horn-color, with dark brown bands and spots arranged obliquely across the whorls. Aperture, when viewed from below, nearly circular. Lip simple and sharp. Whorls six in full-grown shells. In young specimens the shell is carinated, that is, the outer whorl is keeled or angulated, instead of rounded. The base of the shell is lighter in color than the upper surface. Colorless shells are sometimes found. Diameter about one inch.

This is one of the most common species of snail in New England, though occurring only in certain localities; it generally occurs in great numbers. It is found in forests, and sometimes in open fields in damp situations. On islands they often occur in the greatest profusion. When in captivity, they lie buried most of the time under the moist earth, and appear to suffer more from the want of moisture than other species.—*To be continued.*

PARASITIC PLANTS.

BY G. D. PHIPPEN.

Fig. 1.

To persons familiar with the principles of cultivation, and with more or less knowledge of our native plants, the fact that there are tribes of plants in other regions of the earth, that, without any attachment whatever to the soil, grow and produce flowers of the most novel form and brilliancy of colors, seems wonderful in the extreme. Such are the Epiphytes, or air-plants of the tropics, whose seeds, lodging on the branches of living or decayed trees, or even upon the very rocks, readily vegetate, and draw from the surrounding atmosphere the constituents of their growth.

This is accomplished chiefly through their roots, as in

other plants; and as they are found to increase with much greater luxuriance in the recesses of the forest, by the banks of streams, in a sultry, humid atmosphere, we see less difficulty in comprehending the possibilities of their growth and the economy of their being; indeed, their nature is now so well understood, that they are cultivated with ease in our conservatories.

We do not, however, intend to write of air-plants, as our country produces none; but we have, among our native plants, those whose methods of growth are perhaps scarcely less novel and wonderful; such as our parasites, which derive their nourishment from other living plants to which they adhere,—depending upon the leaves and roots of such plants for the necessary contact with the atmosphere and the soil.

The name Parasite is of great significance, for such plants are robbers in the fullest sense, and live solely at the expense of their neighbors.

The most marked example in this region of such anomalous plants is the Dodder. Our species, the Cuscuta Gronovii (*C. umbrosa* Torrey, or *C. vulgivaga* Englemann) is as strongly marked, and more widely distributed than either of the other American species.

The genus Cuscuta has generally been appended to the Convolvulaceæ, or the Convolvulus tribe, which consists chiefly of twining plants, and have regular monopetalous pentandrous corollas, and two to four-celled capsules, with large seeds. This order is well represented by the Cypress vine and the Morning-glory.

The Cuscutas have no leaves, for these plants need none; all the necessary functions of leaves, as has been stated, being performed by the leaves of other plants on which they grow. They have, however, a few minute

scales in alternate succession, which are in place of leaves, and from their axils spring the branches. (See Fig. 1.) Although so anomalous as these plants are supposed to be, yet the right of being perfect plants must be conceded them, and they are properly assigned a place with other Convolvuli.

Eight or nine species grow freely in this country, two of which are found in New England.

C. epilinum, or the Flax Dodder of the old world, mentioned by Gerard and more ancient writers, is naturalized here to some extent. It is said to grow only upon flax, to which it is a great pest, spoiling large quantities. It was noticed by Dr. Cutler as being destructive in his time; but as that useful plant is now seldom cultivated in this region, the Flax Dodder is but rarely detected. A monograph of the American species, prepared by Dr. George Englemann, of St. Louis, can be found in Silliman's Journal, vols. 43, p. 333, and 45, p. 73.

Under the name *C. Americana*, the various native species were for a long time confounded. The botanical text-books tell us that the seeds of this strange plant germinate in the earth in the ordinary manner, throwing downward a root into the soil, by which for a short time the tender plantlet is sustained, until it elongates its thread-like stem sufficiently to reach some foster-plant, around which it immediately twines, and into whose tender bark it thrusts aerial roots, which feed upon its juices; after which, no longer needing attachment to the soil, the primitive root withers away.

After many times plucking the cord-like stems of this plant, and noticing the decisive development of its flowers and seed (for they are as perfect as upon leaf-clad plants), we resolved to prove, with our own

eyes, its double nature and singular method of growth. Accordingly we procured some perfect seed of which the wild plant produces an abundance, and of a size by no means diminutive, and planted them in a bed with other seeds, in small rows, each appropriately tallied, and all designed for transplanting, in due time, to suitable places in the border. In a very few days after planting, the Cuscuta-seed uncoiled its feeble embryo, and erected its simple yellow thread into the sunshine and air; but while we waited for further developments, the spring winds and the warm suns of noon quickly withered them away.

Thus our first attempt at cultivation utterly failed, and solely for the want of some older plants in sufficient proximity for the young seedlings to cling to, but which at the time escaped our reflection. Months elapsed before the experiment was again tried, which was done within doors and in mid-winter with perfect success. The seed readily germinated as before, and when the young plants were about an inch in height, they were taken separately from the earth, and placed here and there on the axils of the leaves of plants near at hand, such as Fuschias, Geraniums, and sundry hanging plants.

With the instincts of their nature (if it be pardonable to use that term), they in a few days attached themselves to these plants, particularly to the Fuschias; and as the spring advanced, they grew with great luxuriance and flowered freely, but, as might be supposed, to the manifest detriment of the plants about which they twined. This, however, was overlooked in the satisfaction arising from success; for had their yellow stems been gold, and their clusters of flowers pearls, the satisfaction would hardly have been greater. Those placed on the hanging plants, although they adhered, made but feeble growth.

One seedling placed upon a plant of *Dielytra spectabilis* did not twine or extend itself with much freedom, but, taking a turn or two near the extremity of one of the branches, it there expended its strength in perfecting a large conglomerate cluster of one hundred or more bells of unusual size and purity of color. In the process of transplanting from the earth to their aerial abode, we at first attempted to convey a ball of earth with each seedling, but this was soon found to be worse than useless.

C. Gronovii, the species under consideration, is found in low damp places, and by the side of brooks and ponds, twining and climbing over such plants as the Willow and Cephalanthus, Decodon and Lythrum, Solidago and Impatiens, to which it attaches itself by "tuberculous processes" or "radicating papillæ," as its roots or suckers, under the partial knowledge of their nature, have hitherto been called. This plant grows often to the length of five or six feet, with its branching, leafless stems, considerably resembling tangled cord, and are of a deep yellow or orange color, being thickly studded with cymose clusters of small white bell-shaped flowers, somewhat like those of the Lily of the Valley, but much more diminutive. We have seen this plant growing on the banks of Ipswich River and its brooklets, in great luxuriance, stretching far over the water upon the deeply-immersed stems of the Button-bush and Decodon.

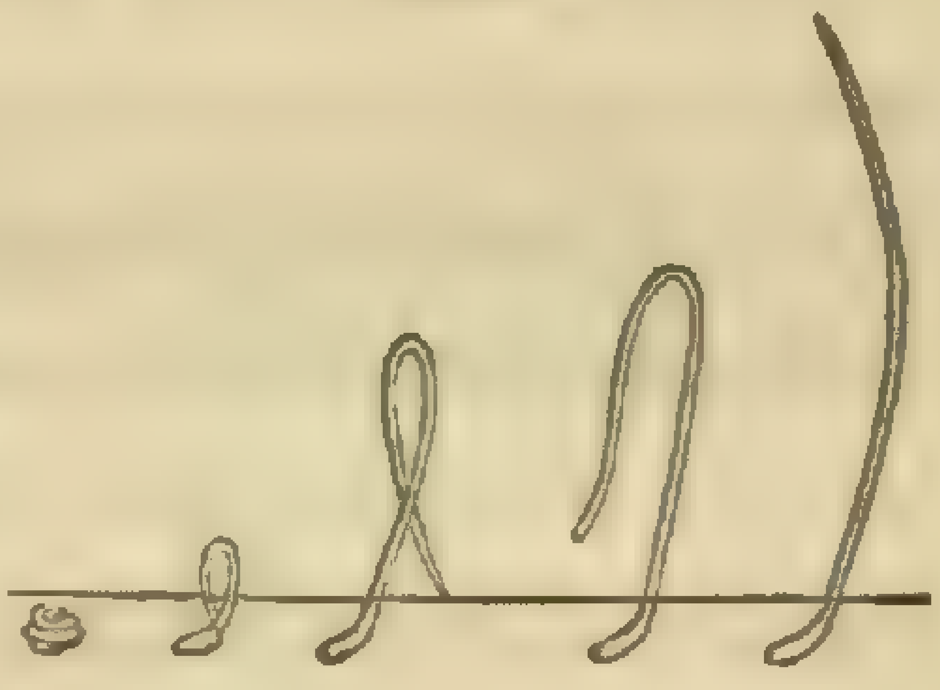
Fig. 2.

This species of Cuscuta does not appear to have any partiality to particular species of foster-plants, but freely attaches itself to such as grow within its reach (Fig. 2). Its flowers, or little globose bells, consist of short five-lobed tubes, with calices similarly divided, and five

stamens inserted between the lobes of the corolla, upon peculiar scaly fringes, not visible in the drawing, which are an expansion of the filaments of the stamens.

The seed contains a filiform embryo, without cotyledons, lying spirally coiled in fleshy albumen, and is distinctly discernible while the seed is in a green state; and here we see written, in the spiral form of the dormant embryo, a prediction of the character of the future plant. In the process of germination this embryo simply uncoils itself; one end as a radicle strikes downward into the soil, while the other, as a plumule, rises from the earth, first breaking ground in the form of a loop, then when the point becomes disengaged resembling a fish-hook, and finally appearing quite straight in its effort to reach some friendly support (Fig. 3).

Fig. 3.



It is generally represented in plates as rising in a spiral form, as also are the branches of the older plants, but this form is not manifest while the unsupported thread is stretching upward for succor, as if attracted by some neighboring object; it is only when the stem is obstructed, or when it reaches the coveted prop, that the spiral form is assumed, and then it becomes very quickly apparent. This is probably true of all twining plants. We have seen the tendril of a squash vine rolled into a perfect ball, when beat by the wind against a stone-wall, the irregularity of whose surface it in vain tried to grasp; while others upon the same plant, not meeting with obstruction, were nearly straight.

The radicle, which is club-shaped, is often turned up in form like a boot; it never increases in size, or ramifies in the ground, but is sufficiently absorbant to keep the

young plant alive for some time, but not enough so to add materially to its primitive development. If at this time a young plant be pulled from the earth, and laid upon its surface, or placed upon some other plant, it will live many days without attachment; and here we see a wise provision of nature, adapted to the peculiar circumstances in the infancy of the plant.

Generally, on the fourth or fifth day after the feeble seedling has been placed upon its guardian branch, it will make one turn around the stem, and the tubercles will immediately appear on the inner side of the twining part, and, after a few more days have passed, the work of absorption will commence. These tubercles, as they grow quite near together along the stem, bear a superficial resemblance to the feet of caterpillars. (See Fig. 1.) Under the microscope each one, in its early stages of development, appears to be composed of a circle of smaller prominences, which finally unite in forming one root or sucker. As the plant continues to twine, these papillæ rapidly multiply wherever the stem closely touches other living tissue, and they are found to unite readily even on other parts of its own stem; they often incipiently form along the inner side of the vine, when at a considerable distance from contact. After passing many of these papillæ under the microscope, we at last detected the manner of attachment and the character of the union.

From the depression in the centre of the above-described circle of swollen cells, a very manifest horn-like process protrudes, and inserts itself into the tissues of the foster plant, and rapidly unites with it (Fig. 4).

Fig. 4.

Where the supporting stem is succulent, this root plunges far beyond the cuticle, even into the very pith of the

plant, and soon forms a perfect graft (Fig. 5). The cells of the parasite can be traced deeply imbedded, until lost at the margin, among the cells of the guardian plant, which is thenceforth compelled to support the vine to fruition,—expanding its flowers, and perfecting its numerous progeny of seeds.

Fig. 5.

Though these aerial roots (which are the only true roots the plant has), are thus seen to penetrate to a considerable depth, their union is of such a character, and the absorption and assimilation of the two classes of cells so gradual and complete, that no manifest swelling of the tissues of either plant in contact is visible.

When grown within doors, the plant is somewhat green, and does not take on that deep orange color, so general in its native state.

Such are a few observations that this humble plant has afforded. It merits farther investigation, and, in the economy of its nature, is as worthy an object of study as the venerated oak, or the tree that yields us fruit.

Among our wild plants are to be found many others of a parasitic nature. With but a passing allusion to the lichens, fungi, and mosses, many of which grow by attachment to other plants, and are more or less Epiphytic in character, we proceed to notice a peculiar tribe of abnormal plants, that however much they may resemble fungi in certain aspects of their being, yet, as they have flowers and fruit conformable to those of the highest organization, will ever maintain a place among true phænogamous plants, such as Beech Drops,—Epiphegus, and different species of Orobanche,—whose seed are said to germinate only in contact with the roots of beech, or other favorite of the particular species. In the subdued

light of the forest, these verdureless plants elevate their brown and yellow stems, covered with scales instead of leaves, but having perfect flowers.

The Monotropa,—Indian pipe or Pine-sap,—more fungus-like still, holds a rightful place among the Pyrolaceæ, or Heaths, and with its clusters of white or tawny stems, each crowned with a large distinct flower, grows from the decayed roots and leaves of the oak and pine.

It has also been found that sundry leaf-bearing genera, situated at no great remove from the Orobanchæ are more or less parasitic upon the roots of other plants; and it is probably from this cause that the Castilleja, or painted cup, the Gerardias, and Pedicularis are so difficult, or so nearly impossible to cultivate. We have often transplanted them from their native wilds to the garden, and have as often met with disappointment. An English species of Comandra, similar to our Thesium umbellatum, whose fascicles of flowers remind one of diminutive bunches of white lilacs, is also said to form parasitic attachments upon the roots of trees.

OYSTER CULTURE.

BY F. W. FELLOWES.

Beyond dispute or question, the French government has taken the lead of all the world in the scientific propagation and skilful culture of the oyster. For the past six years, the great discovery by the distinguished French savan, Professor Coste, of the mode of reproduction of this mollusk, has been converted to practical use; and in suitable localities on the western coast of France, imperial farms, or *parcs*, as they are called, have already

been put into successful operation. Many hundred million of these delicious bivalves (they are sold in France by the hundred, or count, and not by the bushel as with us) now flourish and fatten in shallow bays and basins, where, a few years since, not a solitary specimen could be taken, owing to the thoughtless and improvident industry of the fishermen, who captured and sold every oyster they could find, regardless of season, size, or condition. As a natural consequence the native growth was exterminated, and it seemed probable that a source of profitable labor was gone forever from a very considerable number of the fishing class on the seaboard, who, in over-populated France, could ill afford to lose one chance of earning their few sous a day; while, on the other hand, the tables of the rich were likely to be deprived of one of their favorite and most esteemed luxuries.

Just at this time, in 1858–9, Professor Coste settled a long-mooted point in natural history, namely, that the oyster—in common with many of the lower order of acephalous animals—is hermaphrodite, combining both sexes in the same individual, and his theory of its generation is substantially as follows:—

Possibly the second year, but certainly the third year, the oyster reproduces its kind. During the summer, at seasons varying with locality and temperature from April to July, many hundred thousand ova are simultaneously produced in *capsules* provided for them; these ova are fecundated at an early period of their growth, long before their increase of size and weight causes them to burst the ovarian capsules, and commence their existence in the milky fluid which is prepared for them at this time. The ova are especially enveloped and protected by the branchial folds of the

mother oyster. By an admirable provision of nature, this milky fluid now begins to dry up and thicken, forming a paste which deposits upon the ova exactly what is necessary to form a delicate shell in a few hours, when brought into contact with the salt water by expulsion from the shell of the parent oyster. No sooner is one brood thus sent out into the world of waters to shift for itself, than this process is immediately repeated, and it is known that an adult oyster produces between two and three million of young during a season.

Although the oyster is so remarkably prolific, the "spat" or "spawn" has so many enemies who feast upon it, and there are so many chances against its safely finishing the second year,—when it is tolerably safe,—that an average of less than one-tenth is permitted to attain a merchantable size.

The spawn does not escape of its own accord from the mother oyster, but is expelled (*lancé*) with considerable force, forming at first a grayish cloud which soon disperses and disappears by motion of the water and by individual action, as each young oyster—gifted with slight filial affection—seems eager to remove as far as possible from its parent and the place of its birth, and fearlessly swims away, henceforward to take care of itself and find its own means of existence. These independent little ones are provided with a special locomotive apparatus,—which is at the same time an organ of respiration, and perhaps of hearing and of vision,—by means of which they disperse themselves at the proper time in search of some hard and solid body like a stone, a branch, or a shell to which they can attach themselves and "settle down" for life.

"Nothing is more curious and more interesting," says

M. Davaine in his "*Recherches sur la génération des huítres*," than to see, under the microscope, these little molusks travel round the portion of a drop of water, which contains them in vast numbers, mutually avoiding one another, crossing each other's track in every direction with a wonderful rapidity, never touching and never meeting."

This curious motive power consists of a great number of hair-like filaments, called *cilia*, which take their rise in a dark-colored fleshy mass that emerges from, and overlaps the valves of the oyster on the edge opposite to, and farthest from the hinge, and operated by powerful muscles, can be at pleasure drawn entirely within the valves.

If the young wanderer meets with any hard substance, it clings to it, and in a few hours—as it is at this time rapidly making its shell—a calcareous deposit fixes it there, and, in due course of time, the cilia drop off. But even if no such suitable object presents itself, these wanderings must certainly soon come to an end.

The base of the locomotive apparatus gradually narrows, this organ becomes more and more prominent, until it is only attached by a single slender membrane to the oyster,—which still continues to travel with it,—when, at last, it entirely detaches itself from the oyster, which at once sinks, incapable of farther motion, while the cilia keep on swimming; but, like a vessel without a helm or pilot, their motion is undirected, they roll over and over on themselves, colliding with everything in their course, and, though they can hardly be said to die, soon cease to move.

As soon as the cilia are removed, the oyster commences life in earnest: lips to seize its food, and a stomach to digest it, are developed; *branchiæ*, or respiratory

organs appear; the heart reveals itself and begins to beat; all the functions necessary for existence are set in motion in good working order; and if fortunately placed for obtaining infusorial and vegetable nourishment, in three or four years this embryo "Cove" or "Millpond" or "Shrewsbury" will become a delicate mouthful for the consumer.

Though there are many other enemies of the modest and inoffensive oyster, there are three which are specially feared, and cause the greatest loss to the planter in American waters, namely, the "Starfish" (*Asterias arenicola* Stimpson), the "Drill" (*Buccinum plicosum* Gould), and the "Winkles" (*Pyrula canaliculata* and *P. carica*).

All are familiar with the appearance of the Starfish, though few, even of old oystermen accustomed to annual losses from this five-fingered pest, are acquainted with the manner in which it is so destructive. Even writers upon the oyster, whose general information upon this subject should have taught them better, have fallen into the same error of supposing that the taper fingers are introduced between the valves, and, in some mysterious manner, kill and devour the contents.

The Starfish is provided with an extensible mouth, situated in the middle of the underside, and can only injure an oyster of a certain size relative to its own. If the oyster is small enough, it is swallowed shell and all; the body is digested, and the shell ejected. But if its victim is a little too large for this operation, Nature has provided this scourge with the power to turn its stomach inside out, envelope the unhappy oyster, and absorb the dainty flesh within by means of gastric juice. A. Agassiz, in "Seaside Studies," speaks of this peculiarity as follows: "These animals have a singular mode of eating; they

place themselves over whatever they mean to feed upon, as a cockle-shell, for instance, the back gradually rising as they arch themselves above it; they then turn the digestive sac, or stomach, inside out, so as to enclose their prey completely, and proceed leisurely to suck out the animal from its shell."

When nothing more within the shell remains to be eaten, the stomach is turned back again, and, gifted with a constant and insatiable appetite, the Starfish is ready to recommence its filthy feeding upon the first oyster within its reach. The countless suckers on the underside of this animal are used only for locomotion, just as the fly walks upon the ceiling by means of a similar contrivance on the feet. The general belief that the Starfish takes its nourishment in some mysterious way by means of these suckers is consequently an erroneous one, as they have no openings at the ends, and do not connect in any way with the stomach.

The Drill is a troublesome and destructive intruder upon the oyster-bed, the more so that, from its small size and rapid multiplication, it is difficult to eradicate from a locality when it has once colonized in force. Whole beds are sometimes taken up and transplanted, to avoid this detestable little thief. A slightly different species of the Drill forms no small item of cheap food for the French peasants. They call it the Bigorneau (*Murex tarentinus*), and, when boiled, the meat is picked out with a large needle. Its flavor is excellent, though it is repulsive in appearance, being of a dark green color, and having a decided spiral tail, which renders it anything but inviting to a person about to eat it for the first time.

The Drill has a dark, ridgy, conical shell, about an inch long, and by the help of a broad, flat, fleshy foot, with

which it is provided, fixes itself exactly over what is commonly called the eye of the oyster, and by means of a rough file-like tongue, which it moves forward and back, over the chosen spot, soon drills a round hole through the shell, and sucks out the life and juices of the oyster at its leisure.

The Winkles are a much larger species of the same tribe, and destroy the oyster in a similar manner, only not being so numerous, they cause less damage, and are not so much dreaded by the oyster planter as the little Drill.

The oysters to be found on the *carte* of any good restaurant in Paris are,—the common oyster, price fifteen cents per dozen; the Ostend, price thirty-five cents per dozen; the Marennes, or green, price thirty-five cents per dozen; and the Imperial, price forty cents per dozen.

Each variety has a peculiarity, and its special admirers. The last three, during the winter months, are fat and full-flavored, though small; the Ostend and Imperial being English born, but cultivated and manipulated in France. The French oyster-shell is more round and flat than our own, the body lying in a sudden deep depression close up to the hinge, while a considerable space of the interior of the shell is unoccupied by anything except the mantle. A dozen of either of the last three varieties is a better appetizer to commence a dinner with, than any kind known in this country; while for cooking in every form, the much larger size of the American oyster renders it by far superior.

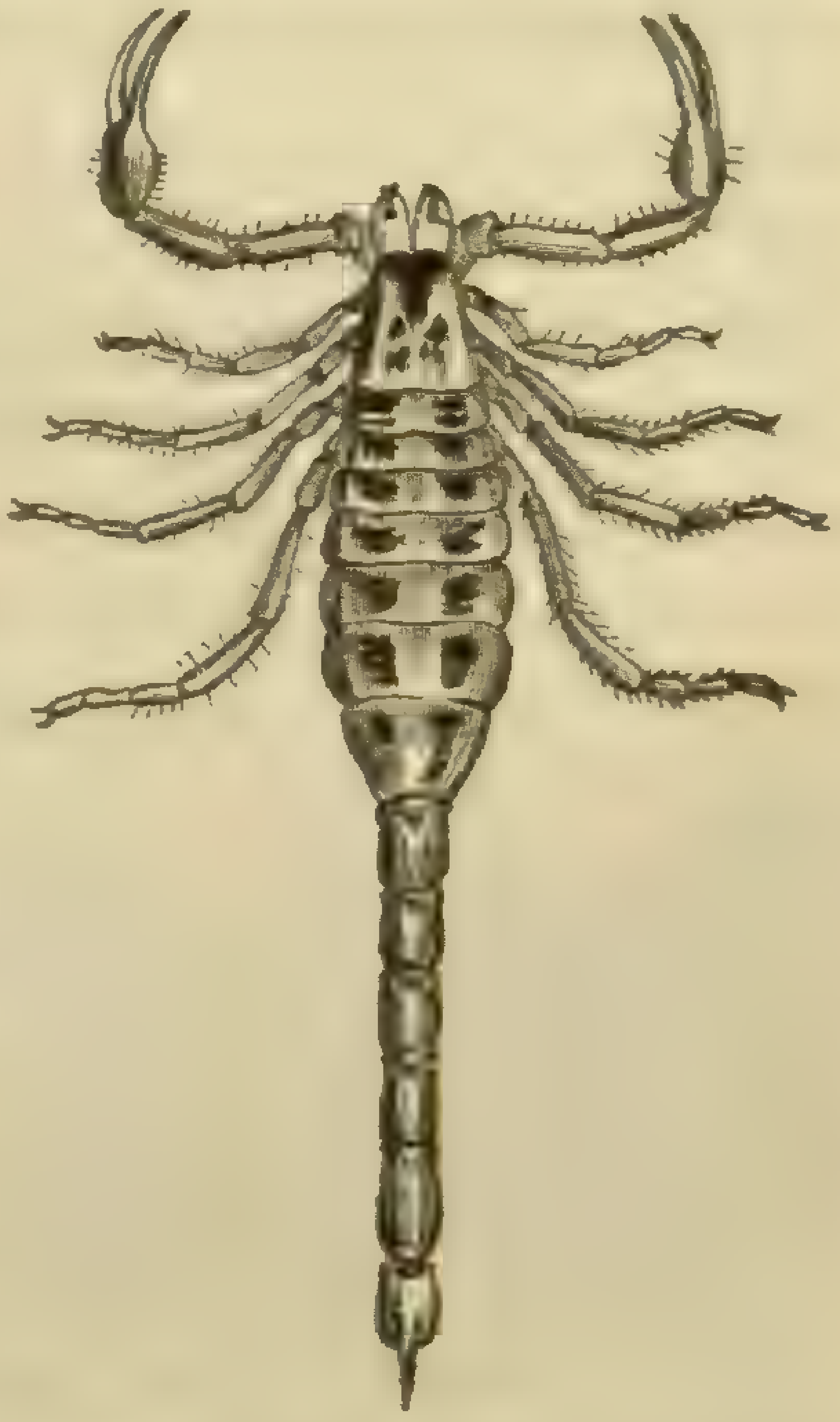
The French lay great stress upon having the shell of this oyster extremely clean (*bien nettoyé*). A gentleman at Marennes, who cultivates the green oyster, has recently erected a tide-mill—for which he has a patent—for the

double purpose of smoothing the roughness and perfectly cleansing the outside, and of wearing off enough weight of shell by *trituration* to save a dollar freight on the railway carriage to Paris, of a *panier* containing a thousand.

SCORPION OF TEXAS.

BY G. LINCECUM, M. D.

THE scorpions of Middle Texas, so far as I have investigated the subject, do not extend beyond a single species. There may be others, but I have not observed them. The species we have is viviparous, carrying its young, eight in number, on its back, until they are three-fourths of an inch in length. When first seen, clinging on the back of the mother scorpion, they are so small that it requires a microscope to examine them satisfactorily. They are white, and look as if they were very tender. They cling tenaciously, and when by violence they are separated from the mother, she shows manifest signs of distress, running about till she comes in contact with the lost ones, when they immediately climb up and cling again closer than before. At this early period, they seem already to be well versed in scorpion tactics, wielding their nimble tail, and its recurved weapon, with dexterity and swiftness.



Scorpions pass the winter in close quarters, and gen-

erally in a torpid state. They are seen early in warm weather coming out at nights, and sometimes during warm damp periods in winter. They are altogether nocturnal in their habits, and are carnivorous, subsisting on insects of various kinds, and even small lizards. As a speciality, they prey largely on crickets. They dwell under old logs, rocks, in old stumps, under the bark of dead trees, under old fences, between the shingles on house-tops, and particularly about the jambs and hearths of fire-places. In temper they are hasty, and will employ their weapons on slight occasions. The pain occasioned by their venom, when injected into one's flesh, is very quickly felt, and quite severe, giving the idea of a burning-hot fluid thrown into the system. It does not last long, nor does it swell much, and is not so painful, nor does it produce so much inconvenience as the sting of the honey-bee. In countries where they abound, people do not regard them with much terror. Chickens are very fond of them, and voraciously devour every one they can find.

I once found a mocking-bird (*Mimus polyglottus*) which by some awkward stroke in his rapid flight, had fractured his right wing. It was running on the ground, and had become quite hungry and light. After dressing and securing the little songster's wing, I turned over some old rails in search of something for him to eat. There were plenty of crickets and scorpions concealed under the rails, for the latter of which he showed the greatest preference. He would peck at them, and by bruising and thus stunning them a little, readily swallow them whole. After he had swallowed seven of them, I thought, as I had volunteered my services as surgeon and physician for him, it would not be prudent for me to suffer him to in-

dulge farther at this time; so I placed him in a large cage with some canary birds, where he remained feasting on nine scorpions a day, until he had recovered the use of his wing, when I set him free.

Scorpions are generally found two or three together, sometimes in larger numbers. They shed their skins without a rent, coming out at the mouth, like the snakes. They moult when they are about half-grown, and again when they come to maturity, and I do not know that they ever again cast their skin during the remainder of their life. They live through two winters, as I can testify, and may exist many years. They are not possessed of much intelligence, making no nests or preparation for winter, beyond crawling under rocks and other dry and sheltered places. Their principal cerebral developments are amativeness, alimentiveness, and cautiousness.

A NOTE FROM THE FAR NORTH.

BY J. T. ROTHROCK.

Early in the year 1865, the writer of this scrap eagerly embraced an opportunity afforded him of visiting the less known parts of North-western North America. The region travelled over lay between the Coast Range and the Rocky Mountains, and from latitude 50° north to 61° north.

From latitude 56°, as far north as Fort Youkon (a post belonging to the Hudson Bay Company, exact position undetermined), a distance of at least 1,500 miles, the country was, and still is, in part, a *terra incognita*. It is to be hoped that erelong much of the uncertainty hanging over it will have been cleared up. Geographers, it is

true, did manage to fill up the blank in a wonderfully inaccurate way, just as they used to—

> "In Afric's maps
> With savage pictures fill the gaps,
> And o'er uninhabitable downs,
> Place elephants for want of towns."

Even of the upper waters of the Fraser, Nasse, or Skena Rivers, no trustworthy chart existed. Much less could we expect those of the Pelly or Liard to be accurate.

At Fort St. James, on Stuart's Lake, latitute 54° 44′, longitude (approximate) 124° 48′, the unknown country may be said to begin. Here for the first time we notice the outlying peaks of another set of mountains, which completely fill the valley (a degree farther north) between the Coast Range and the Rocky Mountains.

These mountains, though known by name to geographers, have always had their altitude underestimated. Near Stuart's Lake they are as high as three thousand feet above the general level of the lakes. At Lake Tatleh they rise to five thousand feet. At Bear Lake, about latitude 56° 15′ N., they are from six thousand to eight thousand, and near Lake Toutah they rise often as high as ten thousand feet. These altitudes are only given as above the general, or lake levels. Add to them from three thousand to five thousand feet, and it will at once be seen that they attain no mean elevation above the sea level. Perhaps I can give no more just idea of the general features of the country around Lake Toutah, than to state that the land rises into a plateau, about 3,500 feet above the sea level. This plateau, lying between the Coast and Rocky Mountains, is dotted over with peaks of the above-mentioned heights. Sometimes neighboring peaks are joined by their bases; often one finds them completely isolated. Nature seems to have set at defiance all law and order,

and to have been governed only by the wildest caprice in their distribution. No axis can be traced, and it is a physical impossibility to walk for a day in a straight line over the prairie plateau at their base. One may ascend, as a rule, the southern slopes of these peaks readily enough, but the northern slopes almost invariably give you from 1,500 to 2,000 feet of sheer precipice at a single leap. Skirting their bases are found dwarfed balsam trees, whose limbs are festooned with the long gray lichen eaten by the Caribou, or now and again a stray cottonwood may present itself. So thickly are the peaks distributed over the country, that the original plateau is seen only as a narrow and almost treeless valley, winding about between the peaks. Yet by following these valleys one may reach the waters of the Liard without crossing a single mountain.

The storms which sweep through the passes must, at times, be fearful. I remember seeing a tree (the largest one indeed which I noticed at this elevation) full two feet in diameter, that had been twisted off by the wind, and carried two hundred feet away from the stump.

Near the top the peaks are bald, and offer no other inducement to the adventurous botanist than a few lichens. Even the snow will not lie on the summits during the winter months, but is blown away into the valleys below, and into the gulches which streak the declivities. Hence, during the winter, when the valleys are buried beneath twelve or fourteen feet of snow, the Caribou seek the mountain tops to eat the lichens. The valleys are worn out into deep gulches by the melting snow, and everywhere you are met by miniature cañons in crossing them. Even in mid-summer the snow falls to a depth of a foot or more, at times, on the mountain sides. Among

these mountains lies Lake Toutah, a beautiful sheet of water, full sixty miles long. At certain places the mountains come jutting down to the very water's edge, and at others recede so as to allow a beautiful open prairie to stretch along the edge. This lake is the head of Finlay's Branch of Peace River, which in turn empties into McKenzie's River. Yet within less than two hundred yards of its southern end rises a tributary of the Skena River, which empties into the Pacific Ocean in latitude 54° N.

The extremes of temperature are great. September 15th, in latitude 56° N., the thermometer stood at 6 o'clock, A. M., at 15° Far., at 2 o'clock, P. M., at 83° Far. After the avalanches and solar heat have carried off the snow from the mountain sides and valleys, the vegetation again starts up with a rapidity that would astonish even a native of the tropics. Hardly a fortnight elapses after giving up the snowshoes, before one finds the lower and more fertile spots covered with verdure, and blooming as a garden. Among these early flowers we find a Nardosmia, Calypso borealis, several species of Violets, a Polemonium, Valerian, etc. These mountains form an Indian paradise. Secure here from any present or prospective annoyance from the whites, the Siccannee, Nahanni, Koninah, and Klo-o-dini tribes hunt the Caribou, Grizzly Bear, Moose, Beaver, and Marten. Perhaps the beavers are nowhere in the world so numerous as among the Peak Mountains. The Indians are, as a rule, friendly, and no man of ordinary courage need to be deterred through fear from going where he lists. To the young, active adventurer, who wishes to make a name for himself as an explorer, no more promising field than the one we have noticed can present itself.

REVIEWS.

PRODROME OF A WORK ON THE ORNITHOLOGY OF ARIZONA TERRITORY. By *Elliott Coues, M. D., U. S. A.* Philadelphia, 1866. 8vo. pp. 64.

This forerunner of a larger work on the Birds of Arizona contains a list of the birds discovered by the author while stationed at Fort Whipple, with which are enumerated all other species ascertained to inhabit the Territory; together with brief critical and field notes, and descriptions of several new species. We extract several paragraphs showing the great interest attending the study of a new fauna, and the relation of animals to the soil they inhabit:—

"The features, dependent upon latitude, which separate Arizona from adjacent regions, to the north or south, are by no means so marked as those which distinguish it from the countries lying east and west, and mainly consist in the introduction into the lower, warmer parts of the Territory, from Sonora, of several Mexican and subtropical species. A "wedge," so to speak, of these types is pushed a little northward of Mexico, and they are readily recognizable as a somewhat prominent element among the birds of Southern Arizona, and of the Colorado valley for a considerable distance. Perhaps this is more decidedly the case here than at other points on our southern border. A considerable number of species properly belonging to the United States Fauna, and generally distributed throughout Arizona, retire in winter beyond the Sonoran border; while at the same time it is interesting to note that some species breed quite high up in Arizona, or even farther north, which are, at the same time, summer residents of the table lands of Mexico. To the northward, neither the climate nor physical geography of Arizona are sufficiently diverse from those of adjacent Territories to produce any special differences in the Avifaunæ, unless indeed the apparent absence of one family can be substantiated as a marked peculiarity.

"Some facts of physical geography have a marked influence upon the birds. From the dearth of water throughout almost every portion of the Territory there results, as a natural consequence, a great paucity of Grallatorial and Natatorial forms; so much so, that with a few prominent exceptions, a list of the Water Birds of the Territory is little more than an enumeration of those of the Colorado and Gila Rivers. There is also to be noted, as an interesting fact, the effect of the hot, arid, desert wastes of the region of the Gila, and Southern Arizona generally, upon the colors of the species found there. A light, dull, apparently faded condition of plumage, in which some shade of gray is a predominant tint, and all lines and streaks are more or less obsolete in character, is met with in numerous instances, forming true local races or varieties. In other cases the specific characters which distinguish birds of this middle southern province from other closely allied species, partake, in a measure, of this peculiarity.

"In this connection I may advert to an interesting point, which I consider as quite probable, though contrary to the usual laws of migration; viz., that many of the birds of the Colorado valley, which are there winter residents, instead of migrating far to the north in spring, by turning simply to the eastward, find in the region of which Fort Whipple is the southern limit the conditions necessary for breeding grounds."

"The seasons are well pronounced at Fort Whipple, and do not differ notably from those of the Middle Atlantic States. This enables us trenchantly to divide those of its birds which are not permanent residents into summer and winter residents, and migratory species passing through in the spring and autumn. And I have noticed in many instances that the times of arrival and departure of non-residents are strikingly similar to those of the migratory species passing through Washington, D. C. Quite the reverse is

the case in southern Arizona; where the protracted heat and drought of a long summer, which encroaches on intermediate seasons, disturbs the regularity of migration; or even entirely takes away from some species the migratory impulse."

The habits of a genus of woodpeckers are thus described:—

"The genus in question is a xylophagous rather than an insectivorous one. I do not mean that the *Sphyrapici* never eat insects, for coleoptera and their larvæ may often be found in their stomachs. But their main sustenance is the cambrium, or soft, inner, *live* bark of trees, the succulent juices of which they appropriate to their economy, rejecting the ligneous, unnutritious fibres in the ordinary method. They are, in fact, true "Sap-suckers," and it is their devastations upon fruit and ornamental trees which have brought the family of woodpeckers into such disrepute among agriculturalists; a class not ordinarily observant enough to discriminate between these birds and the harmless or rather beneficial species of *Picus*, *Melanerpes*, *Centurus*, etc. Instead of simply "tapping" trees, —generally their decayed or dead portions too,—to extract the injurious beetles and their larvæ working within, the Sphyrapicines denude live branches of their bark, often for an area of several square inches at a time. I have before me specimens of wood thus attacked, from which the bark has been removed from large irregularly shaped spaces; and the result, as might be expected, is exceedingly different from that produced from the simple drilling of little holes by the insectivorous genera. Besides the cambrium, all the species, particularly in the fall, feed extensively upon ripe fruits and berries of all sorts."

The occurrence of hybrids between closely allied species of animals is now well known sometimes to occur. The author thus speaks of a hybrid between two species of Junco, the Snow-bird:—

"I have thus gone somewhat into detail regarding the characters of *J. oregonus* and *caniceps*, because in my collection are several examples which I regard as most undoubtedly hybrids between the two. Their general aspect is that of *caniceps;* the head, neck, and throat being slate gray, not black; the lores decidedly blackish, etc. There is a large dorsal area, colored as in *oregonus*, and, most marked feature of all, the sides are strongly tinged with pinkish fulvous, exactly as in *oregonus*, instead of being plain cinereous gray, concolorous with the throat, as in *caniceps*. Other specimens preponderate still more towards *oregonus*, in having the head and neck rather slate black than slate gray.

"The specimens are such palpable hybrids, that they need not in the least invalidate the specific distinctions between the two species. In the case of *Colaptes auratus* and *mexicanus*, it has been proven incontrovertibly, that such a thing is entirely possible between closely allied though quite distinct species."

The Wild Turkey was found to be "a permanent resident of the mountains of the immediate vicinity of Whipple, but quite rare, so much so that I procured no specimens. In some portions of the Southern Rocky Mountains region, it is exceedingly numerous."

NATURAL HISTORY MISCELLANY.

BOTANY.

THE LOTUS.—All the tribes of the White Nile have their harvest of the Lotus seed. There are two species of water lily—the large white flower, and the small variety. The seed-pod of the white lotus is like an unblown artichoke, containing a number of light-red grains equal in size to mustard-seed, but shaped like those of the poppy, and

similar to them in flavor, being sweet and nutty. The ripe pods are collected and strung upon sharp-pointed reeds about four feet in length. When thus threaded they are formed into large bundles, and carried from the river to the villages, where they are dried in the sun, and stored for use. The seed is ground into flour, and made into a kind of porridge.—*Baker's Albert Nyanza.*

ZOÖLOGY.

ARTIFICIAL NESTS OF INSECTIVOROUS BIRDS IN SWITZERLAND.—It is evident that the agriculturist must mainly rely on the insectivorous birds to guard against the attacks of injurious insects. The subject has attracted much attention in Europe. For twenty-five years, M. Auguste Burnat has domesticated in artificial nests, numerous species of birds which have effectually stopped the ravages of insects. Such nests, made of various forms and of different materials to suit their occupants, were placed in the trees in gardens, orchards, and in public promenades and parks. The birds most easily raised were the sparrows, etc. (*Fringilla*, *Sylvia*, *Certhia*), the nuthatches (*Sitta*), and the woodpeckers, which last are very serviceable, as are the martins and swallows. The starling has been raised in great numbers, being more easily multiplied than any other bird.

"During the years 1852 to 1857, the Inspector-General of Forests, M. Dietrich, at Grunheim, in Saxony, reported that two species of Beetles, the *Hylobius abietis* and *ater* [allied to our Pine Weevils], had ravaged to a great extent the firs of his district. During this time there were spent in destroying these insects over four thousand francs, but in spite of every effort the evil still existed. It was then remedied by the Starlings. The inspector placed one hundred and twenty-one artificial nests in the neighborhood of the plantation of pines (*epiceas*). The success was complete. At the end of May, in examining some young Starlings scarcely able to fly, their stomachs were found filled with Weevils, whose "snouts" had been, previously to their being swallowed, broken off by the parent birds. If the Starlings sometime feed on plumbs and grapes, they can be easily frightened off. There are few regions where so much fruit is produced as in the principality of Alenbourg; we may attribute the cause, in part, to the artificial nests established for the Starling. It is the same in Holstein and in Lombardy, where they take the same care in multiplying the Owls."—*Bulletin de la Societe d'Acclimatation.*

We learn that two hundred English Sparrows were last year domesticated in Union Park, in New York city, and that they completely destroyed the Canker-worms infesting the shade trees. Forty pairs have just been imported into New Haven. The English Sparrow also feeds very largely on grain, and may prove troublesome to farmers.

The attention of the Boston Society of Natural History has been called to the thieving propensities of this bird "At a meeting of this Society, held April 18th, Dr. Charles Pickering called attention to the recent introduction of the House sparrow of Europe into this country. As it threatens great evil, preventive measures should be

speedily adopted. Proofs of its destructive habits were cited from standard authors, showing that the bird had been the acknowledged enemy of mankind for more than five thousand years. When writing was invented the sparrow was selected for the hieroglyphic character signifying *enemy*.

"Sonnini, in the Dictionaire d'Histoire Naturelle, published in 1817, says: —

"'Sparrows are impudent parasites, living only in society with man and dividing with him his grain, his fruit, and his home; they attack the first fruit that ripens, the grain as it approaches maturity, and even that which has been stored in granaries. Some writers have wrongly supposed that the insects destroyed by them compensated for their ravages on grain; eighty-two grains of wheat were counted in the craw of a sparrow shot by the writer, and Rougier de la Bergerie, to whom we owe excellent memoirs on rural economy, estimates that the sparrows of France consume annually ten million bushels of wheat.'

"Jardine says that a price is set on their heads because of their severe depredations on grain and garden seed, and Valmont-Bomare makes a similar statement in his Dictionary.

"That their destructive propensities were popularly known in England is shown by Cowper's lines: —

"'The sparrows peep and quit the sheltering eaves
To seize the fair occasion; well they eye
The scattered grain, and thievishly resolved
To escape the impending famine; often scared
As oft return, a pert, voracious kind.'"

Our native insectivorous birds, including the Crow and Robin, which have lately fallen into disfavor, should be carefully protected. They undoubtedly save more money to the farmer in eating grubs, worms, and insects, than he loses by their fondness for grains and fruits. If we destroy the balance of nature, and cause a disproportion between the number of insectivorous birds and their insect food, we shall certainly suffer from the increase of obnoxious insects.

GEOLOGY.

Advance of Geological Science. — In his inaugural address, the President (W. R. Grove) of the British Association stated that most geologists of the present day, instead of holding that the breaks or chasms in the geological record represent sudden changes in the formation of the earth's crust, adopt the alternatives that they arise from dislocations occasioned since the original deposition of strata, or from gradual shifting of the areas of submergence; that the advance of science has more or less filled up the gaps supposed to exist between the characteristics of the extinct and the new species; and that the apparent difficulty of admitting unlimited modification of species would seem to have arisen from the comparison of the extreme ends of the scale, where the intermediate links, or some of them, were wanting.

In these statements the President struck the key-note of the proceedings of the Geological section during the following week. Never, probably, did the authors of papers, or those who took part in the discussions which they elicited, appeal so little to convulsion, cataclysm, or catastrophe. — *Quarterly Journal of Science, London.*

MICROSCOPY.

The Microscope in Medical Jurisprudence. — In a case of poisoning by means of corrosive sublimate maliciously substituted for the proper medicine, and in which there was a doubt of the utmost importance to remove, as to the source of the poison, rendering it uncertain whether the child had met with its death by accident, carelessness, or otherwise, Mr. Deane, by the aid of the microscope, determined, in the most unequivocal manner, that the poison was derived from a small parcel of the same substance, kept in a piece of rag in the house of the child's parents, where it died, thus rendering it quite certain that the death of the child was premeditated, and at the same time removing every trace of suspicion from innocent parties, whose care and common sense had been called in question. — *Address of the President, James Glaisher, of the Microscopical Society, London.*

The Polycystina. — In a paper on the structure and affinities of the Polycystina [one of which, *Podocyrtis Schomburgkii*, is figured on the left side, at the bottom of the title-page of the Naturalist], Dr. Wallich has furnished us with an elaborate account of this obscure family of the Protozoa, and a classification based, as he believes, on the only constant characters it exhibits, viz., those involved in the mode of development and growth of the silicious framework within, and around which their soft part, or sarcode, is sustained. — *Ib.*

EXPLORATIONS AND WORKS IN PROGRESS.

The Lyceum of Natural History of Williams College, propose to send out early this summer a scientific expedition to South America. It will be under the charge of Prof. James Orton, of the University of Rochester. The design of the party, to consist of twelve, is to collect specimens of Natural History, and study the physical geology of the Cordilleras, making Quito the base of their operations. Special observations will also be made on the physical geography of the region, particularly the nature and altitude of the volcanic cones.

This active society has already sent out five expeditions; two to Nova Scotia, one to Newfoundland, one to Florida, and one to Labrador and Greenland. Subscriptions to aid the expedition are desired.

Dr. T. M. Brewer is engaged in preparing for the press the second and last part of the *North American Oölogy*, the first part of which appeared in volume seven of the Smithsonian "Contributions." The eggs and nests of about one hundred and fifty birds will be described. The illustrations will consist of about one hundred figures, in five or six 4to plates.

We have received some advance sheets of a work on the *Ornithology and Oölogy of New England.* By Edward A. Samuels. Nichols & Noyes, Boston. We shall give a farther notice of it hereafter. It will contain over five hundred 8vo pages, and be illustrated by twenty-three plates of Birds, four plates of Eggs, and a large number of wood-cuts.

CORRESPONDENCE.

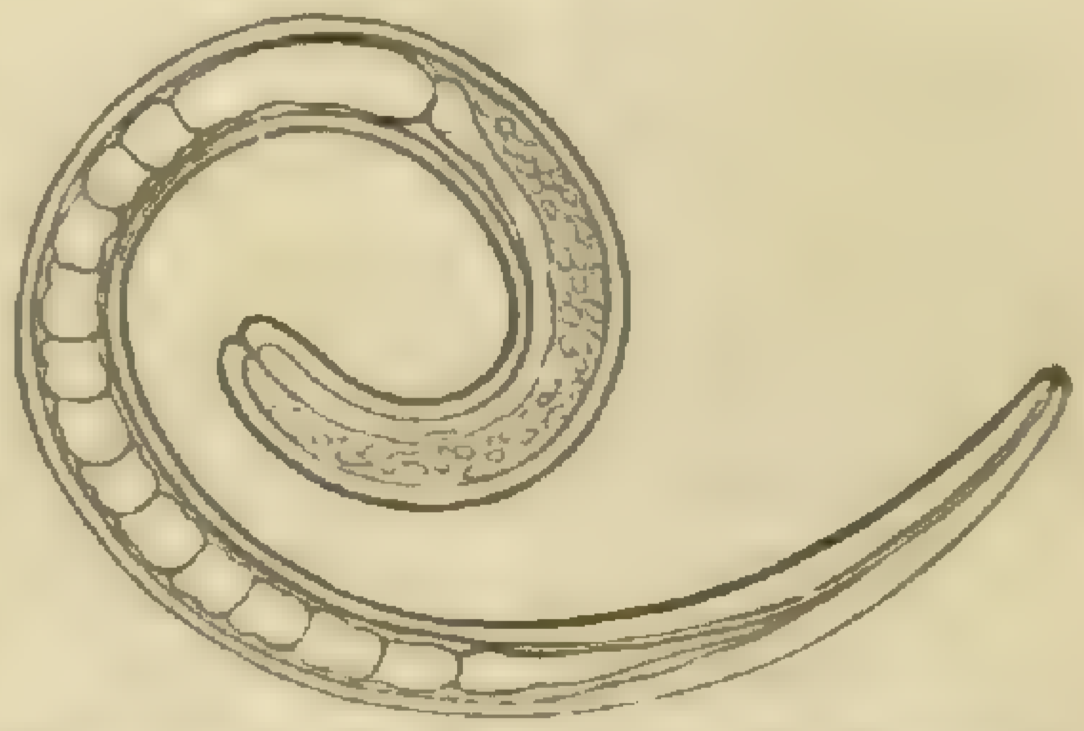
IN answer to several inquiries regarding the disease resulting from eating pork infested by the Trichina, we print the following account kindly prepared for the *Naturalist* by a well-known authority on this subject: —

Trichina spiralis. — This entozöon is the cause of a serious and often fatal disease of the intestinal canal and muscular system of man, called Trichiniasis or Trichinosis, which is produced by eating the flesh of swine similarly affected. Before giving an account, however, of the natural history of this parasite, it may be well to state that trichinous pork is not measly pork. Measles in the hog is the encysted stage of the common tape-worm of man (*Tænia solium*). Measly flesh being eaten, the little cysts or scolices, as they are called, which consist of the future head of the mature animal inverted, escape from their sacs within the stomach, unless previously destroyed by cooking, and attach themselves by their armed heads to the intestinal walls. From this head are developed one after another the joints which make up the body of the tape-worm. The first formed or oldest joints, or proglottides, when sexually mature, escape from the intestinal canal of their host, and, being eaten by swine, the ova they contain are set free. During digestion, the eggshells are dissolved, and the minute embryos find their way into the tissues of their new host, to be again converted into encysted scolices, or measly pork. In this stage the tape-worm is called Cysticercus cellulosæ.

The Trichina spiralis, on the other hand, does not belong to this order of Cestoidea or encysted worms, but to the Nematoidea or round worms (of which the pin-worm is an example), and its development is much less complicated. If trichinous pork is examined by the microscope, the muscular fibres will be found occupied by minute

cysts varying in size, from 1-30th to 1-60th of an inch in length, and 1-100th to 1-150th of an inch in thickness; thirty-five thousand of these have been counted in a single cubic inch of muscle, and it has been estimated that an ounce of such flesh would contain three million cysts. Within them may be seen coiled upon itself, in a spiral form, the young worm, which, when removed by pressure, measures 1-25th of an inch in length, and 1-620th of an inch in diameter. The cysts and young are represented in the accompanying figures. (Fig. 1, the young worm; and Fig. 2, the cysts, after Dalton.) If now such pork is eaten by man, the cysts are dissolved during digestion, and the young worms, unless previously destroyed by cooking, or other process, are set free, to enter the intestinal canal. There they lose their spiral form, increase rapidly in size, and become sexually mature in a few days. Both sexes are at first found in equal numbers, but after impregnation the females alone remain, and by the tenth or fourteenth day the males, which are much the smaller, have all perished. The time required for the development of the embryos is from four to eight days, after which they begin to leave the oviduct in the form of exceedingly small, transparent worms. They may continue to be discharged in immense numbers, however, for six weeks, inasmuch as time is required for the development of the whole number of ova; from three hundred to five hundred in each individual. Immediately after birth the young leave the residence of the adults, the intestinal canal, and give rise to the first symptoms indicative of their presence. They bore into the intestinal walls, and wander along the areolar tissue, penetrating to nearly all parts of the muscular system. Entering the primitive bundles of this tissue, which they devour as they proceed, they increase in size, and finally coil themselves up and remain quiescent. Sooner or later an oval membranous capsule is formed about them, which eventually becomes cretaceous and opaque, and gives to the muscles a white, sanded appearance. The time required for these processes is various. The wandering begins immediately after birth, but it may be several weeks before the whole brood has found its final resting-place. In this qui-

Fig. 1.



Trichina spiralis. Magnified about one hundred times.

Fig. 2.

Trichina spiralis, in cysts, from muscular tissue of Ham. Magnified.

escent stage they may remain alive for many years, and after the death of their host may become mature in turn by entering the intestinal canal of some other host.

The symptoms caused by their presence in man vary according to the number eaten and the stage of development. At first nausea, loss of appetite, and intestinal irritation. Afterwards debility, fever, œdema of the face, movements of limbs painful, and sensitiveness of muscles on pressure. Lastly, great inflammation of intestines with bloody stools, increased muscular pains, partial paralysis of muscles of deglutition, speech, and respiration, and finally death from exhaustion. If only a small quantity of the trichinous pork be eaten, the symptoms will be mild, and in all cases they will disappear when the worms have become quiescent or encysted in the muscular tissue.

The history of the trichina is interesting, and may be briefly told as follows. Many years ago it was found in the muscles of man after death, and described by Owen. Subsequently Leidy found it, also encysted, in the flesh of the hog, and since then it has often been noticed in dissecting-room subjects, giving a sanded aspect to the red muscular tissue. It was always considered harmless, however, and in 1855 Küchenmeister published a theory that it was only the immature form of Trichocephalus dispar, a minute thread-like intestinal worm. Experiments conducted by Virchow and Leuckart, however, in 1859, by feeding animals with trichinous flesh, demonstrated the error of this opinion, and also the important facts that the encysted trichinæ were set free in the intestinal canal, there to become mature; that living embryos were developed within them, which escaped to wander in the muscular tissues of the same host, or might be transferred with the intestinal contents to another animal to become in turn the encysted form; and that the cysts were formed within and consisted of the thickened sarcolemma of the primitive muscular fibres, not, as had been supposed by some observers, within the capillary tubes.

These results pointed unmistakably to the manner in which man also became infected, but they were still considered of no pathological consequence until early in 1860, when a servant girl died in the hospital at Dresden, after a month's sickness, with symptoms like those above mentioned, and on examination after death Zenker found the muscular system filled with free and moving trichinæ. He concluded that it was a case of fresh infection, and that the worms had been the cause of her death. A microscopic examination of the contents of the intestine revealed the presence of numerous mature trichinæ of both sexes, the females still containing living embryos. Portions of the muscular tissue of the girl were sent to Virchow and

others interested in the subject. The former administered it to a rabbit, which was killed by the wandering of the young brood set free within its intestine; the others, as well as Zenker, fed dogs with the same, but the results corresponded with those previously and subsequently obtained, viz., that trichina undergoes only a partial development within their intestinal canal, does not long remain there, and does not wander into their muscular system. It remained to be ascertained where the girl obtained the trichinæ which caused her death. She was taken sick after Christmas in the country where it was the custom to kill swine for the feast of the season, and Zenker, knowing the frequent occurrence of trichinæ in these animals, concluded that some connection would be found between the disease and the meat. On visiting the place, he found that the farmer with whom she had lived had killed a hog on December 31st, and that the ham and sausages, which still remained of it, contained numerous encysted trichinæ. He found, also, that the farmer and his wife and the butcher had all been ill with symptoms similar, though milder, to those the girl had exhibited.

This case, so complete in itself, not only established the connection between trichina in the hog and in man, but demonstrated the existence of an unsuspected and frightful disease, and explained much that had been mysterious in former cases of death from so-called sausage-poison and other unknown causes. It was followed by other epidemics of a fatal character, in several of which the victims were numbered by scores, so that a panic spread over Europe, and the hog seemed doomed to take his proper position as an unclean beast. Scientific commissions have been appointed by many governments to study the disease, and the natural history of this little worm has become of national and political importance, and has received the attention of some of the best scientific observers of the day.

It being established that man gets the disease from swine, these investigations have been directed to the source of infection in the latter animals. Many immature round worms have been found in animals and accused of being trichinæ, but more careful examinations and experiments have subsequently proved their innocence. Among these are to be mentioned worms found in moles, frogs, insects, and angle-worms, upon which swine are known to feed. Even vegetables have been laid under suspicion, and particularly a little nematoid worm which infests the beet-root, but this, too, was found to be zoölogically distinct. Statements have also been made that beef is not free from trichinæ, but there is no just ground for such reports, and the same may be said of the flesh of birds like ducks, geese, and pigeons, which might receive infection by means of the intestinal discharges of tri-

chinous animals, for it has been found impossible to reproduce them by artificial feeding within these animals.

A committee appointed by the Imperial Society of Physicians, at Vienna, has just presented a report on trichinosis, in which it is stated that the real source of infection in swine lies entirely in the rat. In Moravia, thirty-seven per cent. of the rats examined were found trichinized, in the environs of Vienna about ten per cent., and in Lower Austria the proportion was not more than four per cent. The commission also confirms the results of previous experiments, as to the artificial transmission of the disease from the rat to the cat, to the rabbit, and to the pig by feeding. So far as man is concerned, however, it may be safely stated that his source of infection is practically limited to the hog, and there can be little doubt that the disease is kept up between the two precisely as the tape-worm continues to exist. The report of the Vienna commission, even if corroborated by more extended observations, has only added another source of infection in swine; there still remains the fact that many mature females escape from the intestines after impregnation, and in this way may be eaten by the animals. It is well known that when the diarrhœa is severe during the first stages of an attack of the disease, the patient is not so severely affected as others who have partaken of the same pork, and this is due to the escape of the parasite before the young are born in great quantity, and such persons, not sick enough to keep the house, are the probable sources of infection in swine. It has, in fact, been noticed by Virchow, that epidemics succeed each other at regular intervals. After infecting themselves in the way just described, the swine are not again killed until the next general slaughtering season comes, when another follows, to be succeeded by others after a similar interval. It may also be possible that portions of trichinous flesh may pass through the human intestine unchanged and thus be eaten by other animals, or that rats may eat it, and be subsequently eaten themselves by swine. We have seen that dogs cannot be made trichinous by eating diseased flesh, but they may discharge the contents of their intestines containing partially developed trichinæ where swine have access to them; and lastly, it is not impossible that swine may infect each other by intestinal trichinæ alone.

Trichinosis is no new disease. It existed many years ago, and it is undoubtedly as old as the habit of pork eating; we are only beginning to recognize it. In certain parts of Europe where raw pork is largely eaten in the form of ham and sausages, and where the habits of swine and their keepers are not very unlike, there is ample opportunity afforded for its spread and frequent occurrence. In our own country, too, there have been numerous small outbreaks, in nearly all of which

some of the cases have been fatal. Within the last month six cases of the disease have occurred in this State, one of which proved fatal. They were caused by eating raw ham. The most careful attention, however, will not prevent the accidental infection of these animals, as the history of some of the epidemics illustrates. Unfortunately, the disease is latent in them, producing no symptoms which cause its presence to be suspected, and the appearances of the flesh after death are not such as to attract attention. It can only be recognized by its effect on those who unwarily eat it, or by microscopic examination.

In some parts of Germany government obliges all pork to be inspected by an appointed person, before it is sold, and even the butchers are forming associations among themselves for the same purpose, and are learning the use of the microscope, the present horror of pork affording them leisure for such studies. The inspection, however, should never be intrusted to an incompetent observer, and should be thoroughly performed. One of the latest cases of the disease in Prussia was produced by eating flesh which had passed examination, and subsequent investigation showed that only a portion of the shoulder had been sent for examination, and that other parts were abundantly infected. It has been found that the muscles contain most trichinæ nearest their attachments, and that in ham they occur in greatest numbers in these parts about the lower leg. Every hog should be examined in at least five places before it can be pronounced clean, for the parasites are sometimes distributed in the most unequal manner. In Brunswick, out of twenty thousand swine examined, but two were found to be trichinous, but it will be remembered that each of the two great epidemics in Germany were caused by eating the flesh of one animal alone, but these two animals caused the sickness of five hundred, and the death of over one hundred persons.

The results of the investigations of the Committee of the Chicago Academy of Sciences show, however, that the disease prevails among the swine in our Western States to a much greater extent than in Germany, for of 1,394 animals examined, twenty-eight were found trichinous, or one in fifty. Were the habit of eating raw ham and sausages as prevalent in America as in Germany, it will be seen, therefore, how frequent the disease might become amongst us. Fortunately, thorough cooking destroys the vitality of the young worms, but it should be carried to complete coagulation of all the juices of the flesh, even to its very centre, to be effectual.—J. C. W.

W. H. S., Pennsylvania.—It is quite essential for one who wishes to become a naturalist, to know enough of the Latin Language to be able to read Latin descriptions of species, and know the meaning and

derivation of Latin words. A little study will give one enough knowledge of the language for ordinary practical purposes. A large number of scientific terms are derived from the Greek, some knowledge of which is indispensable to the naturalist.

Mr. George B. Emerson, in an article on the Study of Latin Grammar, published in the Massachusetts Teacher, April, 1867, says that "D'Arcy W. Thompson, a man of genius, now Professor of Greek in Queen's College, Belfast, Ireland, author of the 'Day Dreams of a Schoolmaster,' will engage to put all the Latin Grammar necessary to make a good scholar of a boy, into twenty-four pages of a little work that shall sell for sixpence."

Read also the Inaugural Address, delivered at the University of St. Andrews, Feb. 1, 1867, by John Stuart Mill (published in Littell's Living Age, Boston, No. 1,189). This treats in a very comprehensive way of the study of science and the classics. It should be read by every naturalist.

We shall issue a title-page and full index at the close of each volume of the *Naturalist*.

G. W. P., New York.—The insect you enclose is a False-Scorpion (*Chelifer*). The large claws are adapted for seizing their prey, as the habits of the insect are somewhat like those of the Scorpion, though from its different structure it is more closely allied to the Mites.

NATURAL HISTORY CALENDAR.

The Insects of June.—In our monthly calendars we propose to notice more fully than heretofore the *injurious* insects. References to the times of their appearance must be necessarily vague, and apply only, in a very general way, to the Northern States. Insects appear in Texas about six weeks earlier than in Virginia, in the Middle States six weeks earlier than in northern New England and the North-western States, and in New England about six weeks earlier than in Labrador. The time of the appearance of insects corresponds to the time of the flowering or leafing out of certain trees and herbs; for instance, the larvæ of the American Tent Caterpillar, and of the Canker-worm, hatch just as the apple-tree begins to leaf out; a little later, the Plant-lice appear, to feast on the tender leaves, and when, during the first week in June, our forests and orchards are fully leaved out, hosts of insects are marshalled to ravage and devour their foliage.

1st to 15th.—Early in the month the Parsnip Butterfly (*Papilio Asterias*) may be seen flying over beds of parsnips, laying its eggs for

the brood of caterpillars which appear in August. At the time of the flowering of the raspberry and blackberry, the young larvæ of *Vanessa Antiopha*, one of our most abundant butterflies, may be found living socially on the leaves of the willow; while the mature larva of another much smaller butterfly, the little Copper Skipper (*Chrysophanus Americanus*), so abundant at this time, may sometimes be found on the clover. It is a short, oval, greenish worm, with very short legs. The dun-colored Skippers (*Hesperia*) abound towards the middle of the month, darting over the flowers of the blueberry and blackberry, in sunny openings in the forests.

The family of Hawk Moths (*Sphinges*) now appear in greater abundance, hovering at twilight over flower-beds, and, during this time, deposit their eggs on the leaves of various fruit-trees. The American Tent Caterpillar makes its cocoon, and assumes the pupa state. The caterpillar passes several days within the cocoon, in what may be called the semi-pupa state, during which period the chrysalis skin is forming beneath the contracted and loosened larva skin. We once experimented on a larva which had just completed its cocoon, to learn how much silk it could produce. On removing its cocoon, it made another of the same thickness; but on destroying this second one, it spun a third but frail web, scarcely concealing its form. A minute Ichneumon parasite, allied to *Platygaster*, lays its eggs within those of this moth, as we once detected one under a bunch of eggs, and afterwards reared a few from the same lot of eggs. A still more minute egg-parasite we have seen ovipositing in the early spring, in the eggs of the Canker-worm. It has been described and figured in Harris' "Treatise on Insects," third edition, p. 471.

Among that beautiful family of Moths, the *Phalænidæ*, comprising the Geometers, Loopers, or Span-worms, are two formidable foes to fruit-growers. The habits of the Canker-worm should be well known. With proper care and well-directed energy we believe their attacks can be in a great measure prevented. The English Sparrow, Doves, and other insectivorous birds, such as are noticed elsewhere in our pages, should be domesticated in order to reduce the number of these pests. More care than has yet been taken should be devoted to destroying the eggs laid in the autumn, and also the wingless females, as they crawl up the trees in the spring and fall to lay their eggs. The evil is usually done before the farmer is well aware that the calamity has fallen upon him. As soon as, and even before the trees have fairly leaved out, they should be visited morning, noon, and night, shaken*

* Read in the "Practical Entomologist" for April, 1867, an account by the Editor, of the Curculio-catcher, and the true method of shaking or jarring trees. This paper is indispensable to the agriculturist. Published by the American Entomological Society at Philadelphia.

and thoroughly examined and cleared of the caterpillars. By well-concerted action among agriculturists, who should form a Board of Destruction, numbering every man, woman, and child on the farm, this fearful scourge may be abated by the simplest means, as the cholera or any epidemic disease can in a great measure be averted by taking proper sanitary precautions. The Canker-worms hatch out during the early part of May, from eggs laid in the fall and spring, on the branches of various fruit-trees. Just as the buds unfold, the young caterpillars make little holes through the tender leaves, eating the pulpy portions, not touching the veins and midribs. When four weeks old they creep to the ground, or let themselves down by spinning a silken thread, and burrow from two to six inches in the soil, where they change to chrysalids in a day or two, and in this state live till late in the fall, or until the early spring, when they assume the imago or moth form. The sexes then unite, and the eggs are deposited for the next generation.

The Canker-worm is widely distributed, though its ravages used to be confined mostly to the immediate vicinity of Boston. We have seen specimens of the moth from New Hampshire, and Norway, Maine, and Michigan. Last October, late in the month, and in November, we observed numbers of them at the White Mountains flying at twilight.

The *Abraxas? ribearia* of Fitch, the well-known Currant-worm, defoliates whole rows of currant-bushes. This pretty caterpillar may be easily known by its body being of a deep golden color, spotted with black. The bushes should be visited morning, noon, and night, and thoroughly shaken (killing the caterpillars) and sprinkled with ashes.

Among multitudes of beetles (*Coleoptera*) injurious to the crops, are the June Bug, *Lachnosterna fusca* (Fig. 1, from Harris), whose larva,

Fig. 1.

a large white grub, is injurious to the roots of grass and to strawberry vines. The Rose-bug appears about the time of the blossoming of the rose. The Fire-flies now show their light during mild evenings, and on hot sultry days the shrill rasping song of the male Cicida, for they "all have voiceless wives," cuts the air. The Chinch-bug, that fell destroyer of our wheat crops appears, according to Harris, in the middle of the month, and "may be seen in their various stages of growth on all kinds of grain, on corn and herds-grass during the whole summer." So widely spread is this insect at present, that we have even detected it in August on the summit of Mount Washington.

The Diptera, or two-winged flies, contain hosts of noxious insects, such as the various *Cecidomyians*, or two-winged Gall-flies, which now

sting the culms of the wheat and grasses, and various grains, and leaves of trees, producing gall-like excrescences, of varying form. Legions of these delicate minute flies fill the air at twilight, hovering over wheat-fields and shrubbery. A strong north-west wind, at such times, is of incalculable value to the farmer. Moreover, minute flies, allied to the house-fly, such as *Tephritis*, *Oscinis*, etc., now attack the young cereals, doing immense injury to grain.

Millions of Aphides, or Plant-lice (Fig. 2), now infest our shade and fruit-trees, crowding every green leaf, into which they insert their tiny beaks, sucking in the sap, causing the leaves to curl up and wither. They also attack the stems and even the roots of plants, though these latter (*Pemphigus*) differ generically from the true Plant-lice. Fruit-trees should be again washed and rubbed to kill off the young Bark-lice, of which the common apple Bark-louse (*Aspidiotus conchiformis*), whose oyster-shaped scales may be found in myriads on neglected trees, is a too familiar example. Another pest of apple-trees is the woolly Blight (*Eriosoma lanigera*). These insects secrete from the surface of the body a downy, cottony substance which conceals the animal, and when they are, as usual, grouped together on the trees, look like patches of mould. We figure (Fig. 3) from Harris, the *Coccus adonidum* found on the peach. The natural-insect enemies of the Plant-lice now abound; such are the Lady-bugs (*Coccinella*); the larva of the Syrphus-fly, which devours immense quantities, and the larva of the Golden-eyed, Lace-winged fly (*Chrysopa*).

Fig. 2.

Fig. 3.

15th to 30th.—The last days of June are literally the heyday and jubilee of insect life. The entomological world holds high carnival, though in this country they are, perhaps, more given to mass-meetings and caucuses. The earth, the air, and the water teem with insect-life. The insects of mid-summer now appear. Among the butterflies, the Wood-satyrus (*Neonympha eurythris*) skips in its low flight through the pines. The larva of *Grapta Progne* appears on the currants, while the Currant-borer moth (*Trochilium tipuliforme*) darts about the leaves on hot sunny days. The larva of *Cynthia cardui* may be found on the hollyhocks; the pupa state lasts twelve days, the butterfly appearing in the middle or last of July. The *Hyphantria textor* now lays its smooth, spherical eggs on broad patches on the under side of the leaves of the apple, which the caterpillar will ravage in August; and its ally, the *Halesidota*

caryæ we have found ovipositing the last week in the month on the leaves of the butternut. The Squash-bug, *Coreus* (Gonocerus) *tristis*, is now very abundant, gathering about the roots of the Squash vines, often in immense numbers, blackening the stems with their dark, blackish-brown bodies. This insect is easily distinguished from the yellow striped Squash-beetle mentioned in our last number, by its much greater size, and its entirely different structure and habits. It is a true bug (*Hemipter*, of which the bed-bug is an example), piercing the leaves and stalks, and drawing out the sap with its long sucker.

A. S. P.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Essex Institute. *Salem, Feb.* 18, 1867.—Mr. N. E. Atwood, of Provincetown, presented some observations on the different species of whales, and alluded to their food. The Sperm Whale feeds principally upon the Squid, or Cuttle-fish. The favorite food of the Right Whale consists of small crustaceans, medusæ, etc. The Finbacks feed on menhaden, and other small fishes. He then spoke of the relative size of the sexes. The males of the Sperm Whale have yielded as largely as one hundred and forty barrels of oil, whereas the females only yielded from fifteen to twenty barrels. Among the Humpbacks, the females exceed the males in size.

Mr. E. Bicknell made a few remarks upon the microscopic structure of whalebone, stating that, in his opinion, in addition to serving as a strainer to catch the food of the whale, the fringe of hairs, with which each blade is furnished on its inner edge, serves as an organ of touch, notifying it of the presence of its food. This theory is based upon the fact of the hairs being but the termination of a series of tubes, which are continuous from their base to their termination in free ends, and which are filled with a vascular pulp, which he had no doubt contained a nervous substance. The examination of pieces of fresh whalebone would be sufficient to decide the question.

Academy of Natural Sciences. *Philadelphia, March* 12.—Prof. E. D. Cope exhibited a specimen of the skull of a large turtle in a matrix of soft granular limestone, from the cretaceous marl at Barnesboro, Camden County, New Jersey. It was of great interest, not only from the rarity of fossil Chelonian crania in our collections, but from its peculiar structural features. Prof. Ennis remarked on the "Physical Condition and Habits of the Gipsies."

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THE SEA-HORSE AND ITS YOUNG.

BY REV. SAMUEL LOCKWOOD.

"SIR," said an aged fisherman, "there is nothing on the Land that is not in the Sea!" The old waterman's terseness forestalled the philosophic dictum of the poet,—"Whether we live by the sea-side, or by the lakes and rivers, it concerns us to attend to the nature of fishes, since they are not phenomena confined to certain localities only, but forms and phases of the life in nature universally dispersed." Among these forms is a remarkable Order, called by systematists the Lophobranchs, which stand apart from the others by two well-defined, and very curious distinctions. They differ from other fishes in the peculiar structure of the gill arches, by

Fig. 1.

Entered according to Act of Congress, in the year 1867, by the ESSEX INSTITUTE, in the Clerk's Office of the District Court of the District of Massachusetts.

which the gills are arranged in little tufts on each side of the head under the "cheek" bones or gill covers. Hence the name Lophobranch, which is derived from the Greek, signifying tuft-gilled. But, perhaps, more curious is that distinction drawn from their mode of reproduction; a trait so strange, as to suggest the seemingly abnormal habits of the Marsupials,—the Opossum and the Kangaroo,—although the eccentricity of the fish is far greater than that of the land marsupial; for, in the latter, it is the female whose pouch receives the immature young, and which are therein nourished to complete their development. The parental relation of the female Lophobranch, however, is restricted to the simple emission of the unimpregnated eggs. Beyond this, maternity she has none. The male is really, and literally, father and mother to the progeny; and so far as the reproductive instincts are concerned, it would seem that the female manifestation is summed up and exhausted in the one solitary and singular act of a formal consignment of the ova to the embryonal sack of the male.

Though the species of the Lophobranchs are quite numerous, they are all referable to three principal groups or families, of which the Flying Dragon (*Pegasus*), the Sea-horse (*Hippocampus*), and the Pipe-fish (*Syngnathus*) are types. The following observations were made upon the *Hippocampus hudsonius* De Kay, or the common Sea-horse of the Atlantic coast of the United States.

A sea-side residence favoring the design for the past ten years, I have let no opportunity slip of studying the habits of the Sea-horse, hoping to get at some of the necessarily interesting facts which must stand connected with its peculiar mode of reproduction. Owing to difficulties too tedious for detail, nothing like gratifying suc-

cess was attained until the autumn of 1866. Nearly a year had passed without obtaining a single living specimen, when a waterman brought me two full-grown ones, and to my great joy they proved to be "gravid" males. Alas! my oft-repeated experience returned; for, owing to the shock produced by the ordeal of acclimation, they began to involuntarily emit their young. None but a working naturalist can appreciate the anxiety I then suffered. The next day one of my Hippos died, having from debility first set free all its immature young, which were sufficiently developed to indicate plainly their family relation. My estimate was that they were twelve-day embryos. I now redoubled my efforts to invigorate and save the remaining adult, by solicitously watching every circumstance of temperature, æration, and light. In spite of all, the emission of the young went on, until instinct, prompted by increasing debility, led the parent to expel the rest by voluntary effort. *How* this was done was a great point gained. Except a few floating fronds of Ulva, other than the fish, there was no object in the water. And here the structure of the Sea-horse's tail should be borne in mind, so unlike that of any other fish, covered with an envelope, consisting of bony scales; four-sided, and suggesting a small square file; in faculty, prehensile, like that of some monkeys; and of considerable length. Bending this appendage upwards like an inverted crook, thus imparting to it muscular rigidity, the animal pressed it against the bottom of the embryonal pouch, which occupied the lower part of the abdomen, thus pushing its contents upward, and forcing them out of the opening on the top of the sack; the creature all this time sustaining its normal, erect position in the water. The extruded young immediately perished. Relieved of his charge,

my Hippo soon recovered strength, and became for several months a very interesting pet.

September 7. To-day fortune smiled and brought me another "gravid" male Hippocampus. This also, under the weakening effects of acclimation, began excluding the young, having emitted a full dozen. Circumstances favoring, and profiting by a varied experience, I was enabled to carry my new Hippo safely through the dreaded ordeal. Most anxiously was he watched day by day. To my astonishment no enlargement of the embryonal sack could be detected. I supposed that as the young increased in size, the distension of the pouch would go on equally. Again my apprehensions were aroused,—now I feared that the fœtuses were dead!

September 21. A red-letter day! To-day near noon I observed three young Sea-horses swimming about. They had just made their *debut*. Very minute creatures they were; but, to my great joy, nearly perfect. From that hour the *Pater-mater* kept busy setting his progeny adrift. At the bottom of the vessel was a broken Winkle-shell, put there for the attachment of the animal's tail, when fatigued by swimming, as the Sea-horse is very easily tired, and this, monkey-like, is its favorite mode of taking rest. The Winkle afforded real help in the labor of extruding the young, which is in no sense a parturient process, but on the contrary is entirely mechanical, and in the present case was effected in the following manner. With its abdomen turned towards the shell, its tail attached to the under part of it, the body erected to its full height, the animal, by a contractile exertion of the proper muscles, would draw itself downwards, and against the shell, thus rubbing the pouch upward, and in this simple, yet effective way, expelled

the fry at the opening on top of the sack (See Fig. 1). It was said above that the Sea-horse is soon wearied, with even moderate exertion; hence, probably, it was, that these repeated acts were each followed by a few minutes of rest. Indeed, the extrusion of its young lasted for nearly six hours, from three to six individuals being set free at a time.

The scene that followed was one of singular and lively interest. I was nervous with delight, and wished that every Naturalist could see it for himself. I am sure there is no student of nature but will excuse the enthusiasm which prompted me to write at once to a friend, that "he must not set the minister down as a horse-jockey, on being informed that he was now the proud possessor of the most numerous drove of colts ever owned by one man the whole wide world over." Using my best judgment,—for, owing to the mazy motion of this tiny throng, counting was out of the question,—I set the number down as not far from a thousand. Each measured from five to six lines in length. Very minute creatures, truly, when one considers how large a portion is taken up by the tail, which organ was of but little more than thread-like dimensions. We might suppose it would require a few days for the young Hippo to find out the remarkable monkey-like endowment of its tail. Not so. Only look at what my own eyes beheld many a time, when a "stampede" of these little colts was going on, although they were but one day old. There come two little Hippos, each swimming in a direction at right angles to that of the other. Just at the point of passing, one, lasso-like, whips his caudal extremity round that of his fellow, who, of course, in like manner, returns the caudal compliment, which, to speak technically, acts as a "double lock." Of

course both pull, and, by a natural law, the force is exerted in exactly opposite directions, and the right angle is resolved into a straight line. It is but poor head-way they make, nor does it mend the matter much, that a third little fellow comes giddily on, and, switching his tail, takes a hitch at that precise point in space where the other two met. Now a triple force is exerted, and the effect is, with two straight lines to project three obtuse angles. And so the three toil on, obtusely laboring *in statu quo*. But a droller sight is that of yonder juvenile Lophobranch, who seems to be of somewhat belligerent proclivities, as he is leading by the nose a weaker member of his own species, having with his caudal extremity noosed him on the snout. These funny antics, though oft repeated, are of short duration, as the parties soon have to rest, from sheer fatigue.

On the fifth of October the last of my little Hippos died.

In the matter of fœtal sustenance, I find a remarkable marsupial analogy in the Hippocampus. The pouch of the Kangaroo and the Opossum contains teats, with which, by true lactation, the young are nourished until fully formed. Nor is the embryonal sack of the Sea-horse a mere receptacle, or nest, for the hatching of the eggs,—the fish does, in and by the pouch, supply nourishment to the growing young. The mass of fry on the day of its extrusion is certainly in bulk several times greater than that of the original egg-mass. We know that the bear during hibernation lives upon the fat acquired the previous season. During a journey that requires abstinence from food, the well-conditioned camel will subsist on the absorption of its fattened hump. The tail of the frog, which has just completed its last metamorphosis, does not

pass off by atrophy, but is really a wise provision for the creature's support by absorption, during the few days which constitute the most critical period of its life.

This fact I have demonstrated elsewhere by observations from the spawn to maturity. But in these and similar cases, the animal is simply nourished by some superabundance in itself. Ruling out lactation, and the placental phenomena of gestation, is there any instance in which, as a normal fact, the young feeds upon the parent? This fact, seemingly so anomalous, I assert for the Hippocampus, although its physiology I may not be able to explain. The male Sea-horse not only hatches the eggs in the embryonal pouch, but also feeds the young by allowing them to absorb a portion of himself. This is done during the embryo's consumption of the placental yolk, and also, especially and more rapidly, after that source of food is all exhausted. Of course, upon receiving the ova the pouch might be supposed to be considerably distended. This distension is really very trifling. And during development the enlarging of the sack might be expected; but it is inappreciable. At the time of receiving the spawn, the wall of the pouch is not less than three lines thick, and well stored internally with fat. At the time of expulsion of the developed fry, the same sack is not half a line thick, and hangs flaccid on the animal, a mere thin membrane. In due time it becomes again thick, firm, and fat as before, and in such state has been mistaken by me for a gravid condition. This interesting fact of a true marsupial nourishment, and of so unique a character, although suspected, was not accepted, until established by dissection, and observation of a male that had gone through the course described. Moreover, I believe in part may be thus explained the impulse to that forcible

eviction of the immature young, which has been already described. The debility caused by the consumption of the parent, together with the weakening of acclimation, seems to have impelled to the act.

But with the exclusion of the young, the marsupial likeness stops in the Sea-horse, though the young Pipe-fishes are said to reënter the pouch on finding themselves in danger. It is my belief that with the Sea-horse the termination of development is the end of their solicitude for the young.

As to the moral relation of the sexes in this apparently abnormal creature, I must regard it, on the instinctive side, as but little superior to the relation of a pistillate to a staminate plant. The emission of the ova by the one is a simpler matter, all the facts considered, than the seeding of the other. Certainly the love emotion, if any, must be very simple, scarcely more than the poetic figment of the loves of the flowers. Is not the fertilization of the spawn performed by the male after its reception into the embryonal pouch? Besides, that which is usually normal in the female, is in this instance wholly wanting, namely, affection for, and even the knowledge of the young; for she never sees them. Whereas the male, even though pressed by hunger, will not molest his offspring,—a remarkable fact, when we reflect that generally fishes have no scruples against devouring any fry, even their own. This trait of the male Sea-horse is found in the male Stickleback. The former is not very demonstrative, nor can he be, owing to his organization; but the latter is highly so, even to vindictiveness, as I have seen him severely punish the female in his anxiety for the safety of the spawn. There are other undetermined, although interesting facts, connected with this question of sexual relation. What is

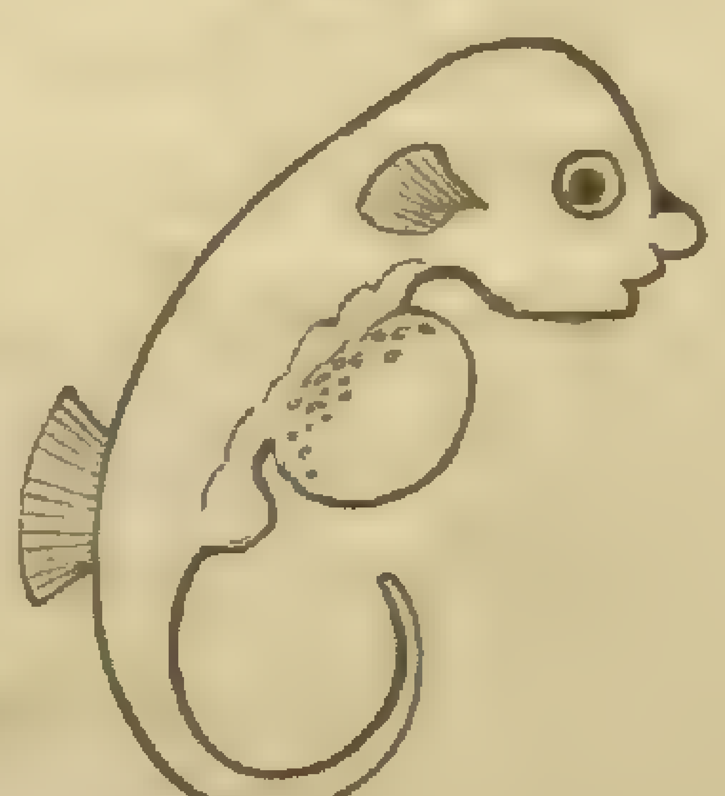
the numerical proportion of the sexes? Does the male incubate the ova of more than one female at a time?

Allusion has been made to the Stickleback. It was to the two-spined species (*Gasterosteus biaculeatus*). This species breeds in the months of March, April, and May. Much depends upon the season. Generally the whole matter is over by the last week in April. My experience, from the examination of many gravid specimens, indicates that the Sea-horse breeds in August and September.

Fig. 2, though drawn without the proper aid from the microscope, is intended to exhibit some of the fœtal phenomena, and represents the premature young, which I have supposed to be twelve days old from the commencement of incubation. Fig. 3 is one of the same magnified, and presents the following particulars worthy of note. First, the tail is round, instead of quadrangular; second, the dorsal fin is set farther back than in the adult; third, the pectoral fins are also farther back on the nape than in the adult (though not to the same extent, yet facts two and three I have seen in fœtuses much older); fourth, the extreme shortness and great width of the muzzle.

Fig. 2.

Fig. 3.



The Sea-horse, when taken fresh from his native home, though almost laughably grotesque, is a very pretty creature. Its general color is ashen gray; at first glance, an exceedingly sober suit. But if examined more closely, it will be found thickly studded with tiny spangles of metallic silver. Add to this its rich armature of daintily carved plates, like a coat of mail, its body always pertly erect, and, bent forward, it looks like the steed of a knight-errant in quest of adventure; and those pretty,

golden, yet queer little eyes, chameleon-like, independent of each other, intently gaze two ways at once. Then as to that dorsal fin, in oddity and beauty it has no compeer among its ichthyic rivals, so tastily fringed with a neat border of delicate yellow, precisely like the yellow tipping of the tail of the Cedar-bird (*Ampelis cedrorum*). In truth, this dorsal fin is cruelly libelled in every engraving we have ever seen. In nature it is an exquisite fan, in form, size, and ornament, worthy the hand of Queen Mab. Thus our Sea-horse, though anomalous in form and habit, has beauty united with its strange features, and grace with its eccentricity. In fine, as we look at his equine appearance, and think of his monkey faculty, and his opossum traits, and that queer blending of innocent oddity with patriarchal dignity, we have to accept the old fisherman's proverb,—"There is nothing on the Land that is not in the Sea."

THE RECENT BIRD TRACKS OF THE BASIN OF MINAS.

BY C. FRED. HARTT, A. M.

(Concluded from p. 176.)

Sir Charles Lyell, who visited Nova Scotia in 1842, first called attention to the recent bird tracks of the Basin of Minas, and Dr. J. W. Dawson, the distinguished Nova Scotian geologist has treated of them in his interesting little volume, "Acadian Geology."

The mud flats of the Minas Basin are made up to a very large extent, some entirely, of these thin layers of mud, deposited by the successive tides. The deposition of the layers does not of course go on equally everywhere, but

only in localities sheltered from the action of too strong currents. In these accumulations there is thrown down a layer for each tide, those deposited by the night tides being thicker than those formed during the day. During a long interval of repose thin layers only are deposited, while just after a heavy storm that stirs up the whole bay, the deposits are much increased in thickness. Nor are these accumulations confined to the shoals laid bare at low tide; but they extend over the bottom of the Basin, though they must naturally be much thicker near the shores whence the materials were originally derived. Dr. Dawson says that "these layers are thicker on the edge of the flats than near the shore; and hence these flats, as well as the marshes, are usually higher near the channels, than at the inner edge. From the same cause, the more rapid deposition of the coarse sediment, the lower side of the layer is arenaceous, and sometimes dotted with films of mica, while the upper side is fine and shining, and when dry has a shining and polished surface. The falling tide has little effect on their deposits, and hence the growth of these flats, until they reach such a height that they can be overflowed only by the highest tides."

It is to the zone embraced between high and low-water marks that the subaerial tracks, such as we have described, are confined, the only markings made on the submerged layers being entirely those of aquatic animals, tracks of crabs and other crustaceans, trails of shell-fish and marine worms, or scratches made by fishes; but markings of this kind may extend over the whole part reached by the tide, while low tide is the lowest limit at which tracks of land animals can be found.

The *Tringæ* and other waders visit the shores of the Basin only in the summer, so that through the whole

series of layers formed during the winter, none of these tracks occur. In the winter months the shores are encumbered with masses of ice and snow, and are quite deserted. The floating ice scores and ploughs up the banks in exposed localities, and the regularity of the deposits must be very much broken during that time. The ice forming on the shores and floated off at high tide carries away an immense amount of shingle and loose material, often large boulders, and drops them over the bottom of the whole Basin, and one sees blocks of trap from Blomidon lying on the flats about Horton and Cornwallis. This annual drift phenomena must leave its record in the boulders and coarse material distributed through the finer material laid down during the winter, while the summer layers would be entirely free from them.

It will be readily seen that the mud deposits can only accumulate in the quieter parts of the bay, and that as we go from these to points where the tidal currents increase in velocity, we shall pass from mud deposits to those of sand and gravel, while the shores will vary in the character of their beaches according to the kind of rock exposed at the water's edge. Thus under the red sandstone cliffs of Cornwallis and Blomidon, we have sand beaches in exposed localities, muddy shores where the waves are shut out, while trap-shingle is strewn along the shores of Blomidon.

The Strait of Minas is very narrow, and one can readily imagine that the immense mass of water which twice a day is poured into the Basin, and twice a day drained off again, must cause tremendous currents setting through the strait, and that wherever these are felt, only the coarser deposits are to be looked for.

These mud banks, these accumulations of sand, gravel,

and shingle really form a great diary of the life of the Basin, and we see that the history that is daily written upon them is readily to be translated. Well, we have got our boots and pants well covered with mud, we have gathered a handful of specimens of bird tracks and a pocket full of muddy shells, and we have learned something of how Nature writes down in her great Stone Book the history of the world. Before us are the last few pages of the manuscript, and we have watched in the tracks left by the running bird, the pen gliding over the page. Aye, we too have added our lines to the history. Will the coming tide respect them and seal them up forever, or will it blot them out as unworthy of a place on the page? Behind us and around us in the hills are volumes written long ago by the same ever-recording pen; but Nature makes *palimpsests*, as did the scribes of the middle ages, and writes over and over on the same page. See, yonder at the mouth of the Avon is a range of cliffs called Horton Bluff, formed of layers of the lower coal measures. They form a chapter in the geological history of the Province, and are written all over with quaint old records of ancient forests of coal-plants, and of antique mailed and spine-armed ganoid fish; but the scribe, wanting material on which to record the history of the present, is destroying the old manuscript, spreading out its leaves anew, re-prepared for the more modern characters in which the chapter of to-day is being written. After all our scribe is but a chronicler, like old Froissart. Geologists are the historians that work over this material. They are not satisfied with leaving the detached facts recorded, but ask the *why* and the *wherefore* of their occurrence and their relations one to another. One who merely translates the detached facts of the geological record is no more

entitled to be called a geologist, than a translator of Froissart can claim to be a historian.

If you were to examine the beds of Horton Bluff, you would occasionally find one on whose surface are markings, such as we observe nowadays being made on the sea-shore; some of the layers are ripple marked evidently by the waves, or by shallow agitated water. All these beds were deposited under water in the shape of sand and mud. The late Dr. Theodore Harding, of Windsor, discovered on the surface of one of these layers, the tracks of a kind of reptile. The animal had evidently walked about over the rock when it was soft, and its footprints were preserved just as the recent impressions of birds' feet are now being preserved on the shores near the bluffs. Tracks of worms are sometimes found on the same beds, and at Parrsboro' we have found what appear to be the tracks of some large crustacean.

Tracks of animals have been formed, of course, ever since the world has been inhabited, and these are preserved in rocks of all ages wherever the necessary conditions obtained, from the Lower Silurian "Lingula flags"* of St. John, New Brunswick, to the deposits now forming.

Many years ago, Dr. Deane found on the surface of slabs of sandstone, quarried in the Connecticut valley, the tracks of a three-toed animal which he took to be a turkey; but Professor Hitchcock, of Amherst, having examined them, showed that they were not made by that fowl, but by some bird-like animal long since extinct. Attention being called to the subject, it was found that these and other footprints were scattered through a great thickness of these sandstone beds, and Professor Hitchcock, before he died, described over one hundred species of animals from

* The writer pointed out the primordial age of these beds in 1865. Mr. E. Billings believes them to be the exact equivalent of the "Lingula flags" of England.

their tracks found in the Connecticut River sandstone. There cannot be the slightest doubt that during the Triassic period the valley of the Connecticut, from New Haven to a point about one hundred and twenty miles north of that city, and with an average width of about twenty miles, formed an estuary, to which the sea had imperfect access, and that the sandstones and shales which now fill it, were therein deposited, under circumstances exceedingly like those under which the mud deposits are now accumulating in the northern estuaries of the Avon and Cornwallis, though there was there a slow submergence going on which gave an opportunity for the distribution of the tracks through hundreds of feet of beds, a thing which would otherwise have been impossible. In this estuary were extensive mud-flats and sand-banks covered by high tide, and left bare when the tide was out, and these were the resort of great numbers of animals whose footprints are alone preserved. The majority of these animals were reptiles, but others were probably birds. Huge fellows were some of them, making tracks about two feet in length. Yet, though these footprints are very abundantly handed down to us, the rocks themselves hold scarcely a vestige of animal remains. Besides a few fish, a shell or two, and an insect, only a few broken bones have been discovered thus far, and these last enable us to form only a suspicion as to the character of the animals to which they belonged. It would be very unlikely that the remains of land animals, which only frequented the shores between the tides, should be found in the deposits there forming, and we have already remarked how rare it is to find a dead bird on the Horton shores.

Some of the shale-beds of the Connecticut valley resemble very closely, both in color, texture, and composition,

the dried mud-layers of the Basin of Minas. I have before me now a slab from one of the finer-grained beds of the Connecticut valley. Except that it is more solid, it could not easily be distinguished from a well-baked specimen of the Minas mud. Its surface is marked with beautifully preserved rain-prints, as clearly impressed as one sees them after a mid-day "sprinkle" on the Horton mud-flats, and to make the resemblance more complete, there is on one side an incipient crack, like the gash of a knife where the mass in shrinking had begun to tear apart, but had not separated sufficiently to form a complete crack.

From these studies we must see that the phenomena going on around us must be the Rosetta stone, which shall furnish us with the key for the deciphering of the hieroglyphics of the Stone Book, and that we shall understand the results of the forces which acted in the past, in proportion as we correctly understand their action in the present.

Let us now see what was going on "down east" when the Connecticut valley was an estuary. Nova Scotia had at that time very much the same appearance as at present, but the land was more sunken, and the range of hills that skirts the Bay of Fundy, the North Mountains, did not then exist. The bay washed the northern slope of the South Mountains, and the Basin of Minas formed the head of the bay. The shores of the Minas Strait were then on the north, very nearly as at present; but Capes d'Or and Sharpe, as well as Partridge Island, and the Two or Five Islands, now noted for their beautiful zeolitic minerals, had not yet a being; neither had Isle Haute lifted its lone head above the waters of the bay. On the south the shore ran along the range of hills, the continuation of the South Mountains, from Kentville by Wolfville, and the

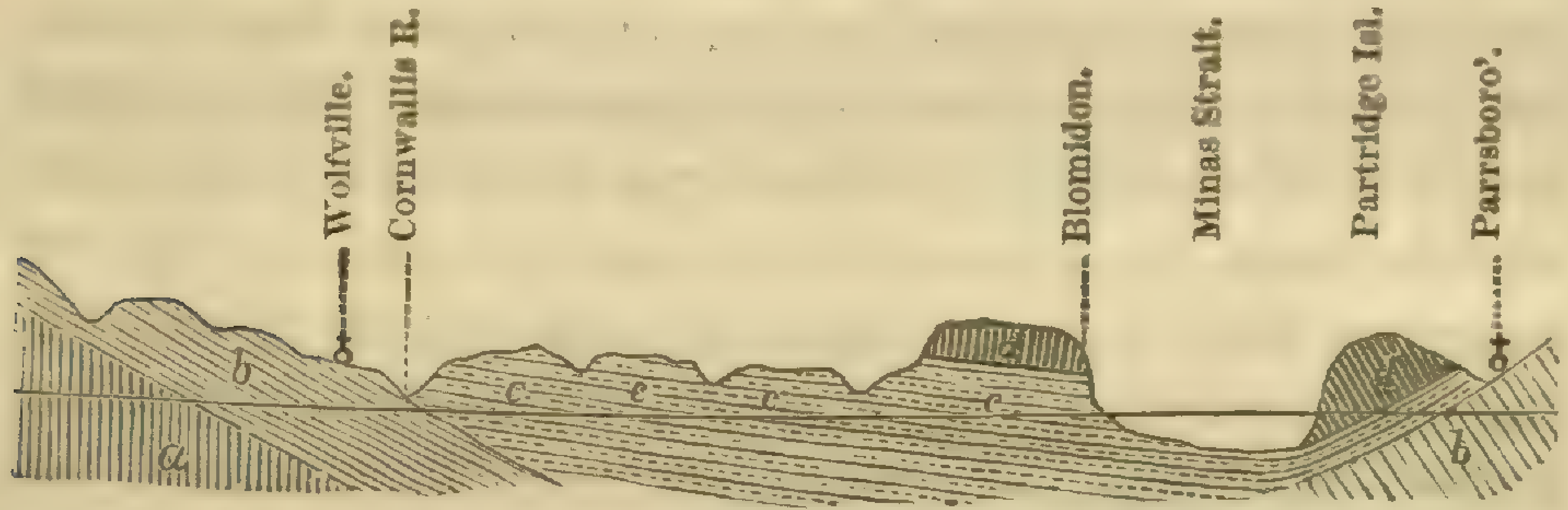
Horton Mountains to Truro. There was then no strait at all. The Basin opened broadly into the Bay of Fundy. Cobequid Bay was much wider than at present, and penetrated eastward beyond Truro. One of the Acadian provinces, Prince Edward Island, was wanting.

Within the whole bay thick beds of red sand were deposited, and similar strata were at the same time accumulating in the Gulf of St. Lawrence, off the northern coast of Nova Scotia, and especially over the area now occupied by Prince Edward Island. These beds now form a coarse friable red sandstone which is almost entirely barren of fossils, for it had afforded only a few reptilian remains in Prince Edward Island. Acadia must at that time have been peopled with animals, and covered with vegetation; but the conditions for the preservation of the remains of either were very unfavorable. The bay was then open to the full sweep of the tide, which may at that time have acted with even much greater force in the region of the Basin of Minas than at present, because the tidal wave, not being obliged to pass, as at present, through the narrow Strait of Minas, would have had an opportunity of exercising its full force, rising higher and higher as it rushed up the ever-narrowing head of the bay, but it may have been that at that time the isthmus which unites the peninsula of Nova Scotia with the main land was submerged, in which case the extraordinary tidal phenomena of the Bay of Fundy could not have resulted. The sandstone beds show, in their oblique lamination, the action of strong and shifting currents. There was not the same opportunity presented for the preservation of such footprints as may have been left on these sands, as existed in the quiet estuary of the Connecticut, or the present Basin of Minas. At intervals during the deposit

of the Connecticut River beds, there were volcanic disturbances, attended by the formation of dykes, and the spreading out over the beds of thick masses of lava. The New-Red Sandstone period was attended in Nova Scotia by similar phenomena. Just after the formation of the sandstone beds in the Basin of Minas and Bay of Fundy, submarine volcanic action broke out along the line of the present North Mountains, and immense quantities of melted matter were thrown up from beneath, and spread over the New-Red Sandstone strata, either in liquid, molten streams, or a volcanic ash. This ancient lava is called *trap.* The volcanic disturbance went on for some time, until these beds had acquired a great thickness. Similar eruptions took place at the same time at the Two, Five, and Partridge Islands, Capes d'Or and Sharpe, and at the Isle Haute. It is very probable that all these now isolated trap masses may have been at that time continuous.

The land was then elevated so as to bring all their beds in the Basin of Minas, and along the shores of the Bay of Fundy above water, and as the red sandstone beds had a slight dip to the northward along the southern coast, the volcanic beds had a like dip towards and under the bay. The trap beds were very thin inland, but became thicker towards the shore. Running water began its work on the southern edge of the trap deposit, along the present line of the valley between the North and South Mountains, and with the assistance of glacial action and the sea, which afterward flowed through it, excavated that depression. To the north, the waves, beating along the whole bay coast for centuries, cut away the trap-beds, so that we have now only a narrow strip left, the North Mountains from Blomidon to Briar Island. At the time of the elevation of the New-Red Sandstone beds, the Basin of

Minas, as well as a large portion of the Bay of Fundy, was occupied with them; but they have since been largely removed, except where overlaid by trap deposits, or otherwise protected, and only small remnants are now left fringing the shores of Nova Scotia and New Brunswick. Prince Edward Island made its appearance with the rise of the land, and it must at first have been of much greater extent than at present, perhaps even having been united to Nova Scotia.



a, Silurian strata. *b*, Carboniferous sandstone and shales. *c*, *c*, *c*, *c*, *c*, Triassic red sandstone. *d*, Trap overlaying red sandstone.

The reptiles and birds of the New-Red Sandstone period have passed away, and the earth is peopled by a new creation. In that period the world had reached that stage in its development when it was fitted for the rule of the brute force of giant reptiles. To-day *mind* rules. God's other creations signed their mark on the pages of geological history.

NOTE.—The above diagram is an ideal vertical section across the country from Wolfville to Parrsboro', intended to show the relative position of the beds of rock of which it is composed. The hills south of Wolfville consist of beds of sandstone and shale, *b*, belonging to the lower part of the Carboniferous formation. These beds are inclined to the north, and they rest on the upturned edges of beds of slate, *a*, of Lower Silurian age. Carboniferous beds, *b*, appear at Parrsboro', but they are much newer than those near Wolfville. In the trough-shaped depression in these Carboniferous strata, the ancient Basin of Minas, lie the thick beds of the New-Red Sandstone, *e*, *e*, *e*, *e*, which, except where they are protected by the overlying masses of trap, *d*, *d*, at Blomidon and Partridge Island, are worn away into low hills, or cut through by the river or the water of the Strait. The horizontal line represents the sea-level. This section is based on one by Dr. Dawson, in his "Acadian Geology," with additions by the writer.

SOMETHING ABOUT JELLY-FISHES.

BY EDWARD S. MORSE.

PLATE 8.

The loiterer by the sea-side may have noticed in his rambles on the beach, certain gelatinous substances left by the retreating tide. An interest excited by so strange a sight may have prompted a closer examination, and yet recognizing nothing tangible or definite in the structure of these shapeless bodies, a desire has been really awakened to know something about them. We will try to satisfy this curiosity, by giving a brief account of a few of our more common Jelly-fishes; for these shapeless lumps of jelly, seen stranded on our beaches, are really animals, assuming the most graceful and symmetrical forms in the water.

The Jelly-fishes, or Medusæ, have long excited the attention of naturalists from their singular structure, and the wonderful changes occurring during their growth.

While in the higher expressions of animal life the anatomist may puzzle over the intricacies of a complicated organization in the Jelly-fishes, he is at first more perplexed to find anything like organization in their parts, though they are really highly organized compared with animals still lower in the scale. So transparent are some, that one can hardly detect their presence in the water, and so largely does the sea-water enter into their composition, that certain kinds when dried lose ninety-nine one hundredths of their own weight.

Peron and Lesueur, two distinguished French naturalists, who, in the early part of this century made a voyage around the globe, thus summed up the results of their combined observations on these animals. "The substance

of a Medusa is wholly resolved, by a kind of instantaneous fusion, into a fluid analogous to sea-water; and yet the most important functions of life are effected in bodies that seem to be nothing more, as it were, than coagulated water. The multiplication of these animals is prodigious, and we know nothing certain respecting their mode of generation. They may acquire dimensions of many feet in diameter, and weigh, occasionally, from fifty to sixty pounds; and their system of nutrition escapes us. They execute the most rapid and continued motions; and the details of their muscular system are unknown.

"Their secretions seem to be extremely abundant; but we perceive nothing satisfactory as to their origin. They have a kind of very active respiration; its real seat is a mystery. They seem extremely feeble, but fishes of large size are daily their prey. One would imagine their stomachs incapable of any kind of action on these latter animals: in a few moments they are digested. Many of them contain internally considerable quantities of air, but whether they imbibe it from the atmosphere, extract it from the ocean, or secrete it from within their bodies, we are equally ignorant. A great number of these Medusæ are phosphorescent, and glare amidst the gloom of night like globes of fire; yet the nature, the principle, and the agents of this wonderful property remain to be discovered. Some sting and inflame the hand that touches them; but the cause of this power is equally unknown."

Professor Richard Owen quotes these "lively paradoxes" to show the progress made since then in clearing up many points that were obscure at their time, and to show that even the skilful naturalist, with abundant material at hand, may plod on with uncertainty unless aided by the higher powers of the microscope. Recent works published by

Professors Agassiz and Clark, and Mr. A. Agassiz, have detailed very fully the anatomy and classification of our native species.

The Jelly-fishes of our coast are represented by numerous globular and disk-like animals of a gelatinous texture, more or less transparent, having certain appendages consisting either of longitudinal bands of vibrating fringes, as in one order; or, as in another order, having appendages surrounding the mouth, and others, thread-like, hanging from the margin of the disk. The parts most conspicuous within the body are the ovaries, or egg-sacks, the stomach, and certain tubes running from the stomach to the periphery of the body.

These animals are apparently radiated in their structure; at all events, it is difficult in certain groups to distinguish a right and left side, and for this reason they are called Radiated animals, and form one of the three classes of the branch RADIATA.

The Jelly-fishes of our coast are common in our harbors and inlets, where the water is fresh and pure from the ocean. A very ready and convenient way to collect them is to moor your boat on the shady side of a wharf where the reflected rays of the sun are avoided, and, as the tide sweeps gently past, to dip them as they are borne along by the current. Some little practice is necessary to discern the smaller kinds, for many species are very minute, and other species, though of good size, are nevertheless hard to distinguish on account of their extreme transparency. They may be dipped from the water with a tin dipper, though a wide-mouthed glass jar is better for this purpose. As they are secured, they may be poured into a wooden pail for assortment and examination at home; or, better, a large glass jar, carried on purpose

to hold them, may be filled at once, as too frequent changes destroy them.

Some species are very hardy, and may be kept alive for weeks, while others live only a few hours, gradually diminishing in size till they appear to melt away in the water.

Among the more common forms met with on our coast is the *Pleurobrachia* (Plate 8, Fig. 8). Words fail in describing the beauty and singularity of this Jelly-fish. Conceive a globular body the size of a walnut or larger, but perfectly transparent, having eight bands of rapidly vibrating fringes surrounding the body, running from one pole to the other like the ridges on a walnut, and two thread-like appendages, festooned with hundreds of shorter threads, trailing out behind the body like the tail of a comet, and you have a general idea of this Jelly-fish.

The zones of vibrating fringes act like so many little oars, and impel the body through the water. At times, only the fringes on one side are in motion, and then the body rotates in the water like a vital globe. Anon, the different zones alternate in action, and the body describes a spiral course in the water. The most beautiful prismatic hues are exhibited when these fringes are in motion, and these brilliant changing colors often lead to their detection in the water. The long thread-like appendages, already mentioned, are the most wonderful portion of the structure of this Jelly-fish. They are lined with hundreds of smaller threads which start at right angles from the main threads, and are all of the extremest tenuity. The distance these appendages can be projected from the body, the instantaneous manner in which they are drawn within the body, and the perfect control the animal manifests in their movements seems incredible,

until the movements have been actually witnessed. When contracted, these appendages occupy a space of exceeding minuteness, and when projected from the body seem to run out as a cable runs from a ship. We have sought in vain for any definite solution of the function of these threads, and are compelled to offer one derived from our own observations. Beside the locomotive power derived from the longitudinal zones of fringes, the body will be seen to oscillate to and fro, this motion being produced by the alternate contraction and relaxation of these threads, the resistance offered to the water by the sudden contraction of the expanded threads being sufficient to oscillate the body. The Jelly-fish in question, unlike most members of the class, swim with the mouth upward, and the appendages start from the pole opposite the mouth; and since the mouth is unprovided with any organs whereby to grasp food, the mouth has the power of sweeping back and forth in the water by the oscillations of the body, affording greater chances of coming in contact with their food. It has the power of seizing little shrimp-like animals, and a singular sight it is to see this Jelly-fish, with its repast perfectly visible within its transparent body.

There are two other forms of Jelly-fishes not uncommon in our waters, which have the zones of locomotive fringes, but have no trailing appendages, as in the species just described. One of these forms is called Bolina, and is somewhat larger than Pleurobrachia, being pear-shaped, and the larger end divided into two lobes which surround the mouth. These lobes have the power of expanding and contracting, and the contour of the animal is materially altered by their movements. They may sometimes be seen gaping wide, disclosing the mouth, and ready to

entrap its food, and again so contracted that the mouth is quite hidden.

Another form called *Idyia* is long and cylindrical like a tube rounded and closed at one end, the other abrupt and open; the open end constitutes the mouth. In fact, it is hardly more than a locomotive stomach. This Jelly-fish has more consistency than those heretofore described, and is quite opake. At certain seasons of the year they are pinkish in color. An individual of this species, when confined with Pleurobrachia, soon manifests its carnivorous propensities by attacking, and often swallowing the Pleurobrachia whole. It does not appear daunted if its victim proves larger than itself, but slowly, patiently engulfs its victim; and a curious sight it is to see the Idyia directly after this feat is performed, presenting the appearance of a tight skin drawn around the innermost Jelly-fish, though in a short time its food is digested, and the Idyia resumes its normal shape, and not in the least augmented in size. It probably requires a dozen or more of such game for an ordinary lunch. This statement will not be wondered at, if the experiment is tried of drying a specimen of Pleurobrachia on a white card, and finding nothing left but a few crystals of salt. The vitality of these Jelly-fishes is remarkable: they can be cut in several pieces, and yet each piece will remain alive for a long time in the water; and one naturalist, after having cut an Idyia in half longitudinally, observed one half to enfold, and digest another Jelly-fish.

The three forms thus far described are common representatives of an order of Jelly-fishes called *Ctenophoræ*, or Comb-bearers, the fringes or paddles having been compared by some writers to the teeth of a comb. These fringes form a distinguishing trait of the order. The

members of this order are reproduced directly from eggs.

We will now consider another order of Jelly-fishes called *Discophoræ*, or disk-like Jelly-fishes, since the form of many species present a disk-like appearance. Members of this order are very conspicuous in the water, owing to their large size, their opacity, and the distinctness of their egg-pouches. They have no zones of locomotive fringes, but hanging below the disk and surrounding the mouth are numerous appendages, and surrounding the border of the disk is seen a delicate fringe of threads interrupted at regular intervals by little dots called eyes. These Jelly-fishes swim in the water by successive expansions and contractions of the disk, making a motion something like the motion made by the partial closing and opening of an umbrella. This motion is very leisurely performed, and the animal appears drifted by the currents and eddies with but little power to direct its course.

Our most common species, the *Aurelia* (Plate 8, fig. 5), occurs abundantly in our bays, sometimes in vast multitudes. When full-grown they measure from twelve to fifteen inches in diameter.

Another form, called *Cyanea*, often attains an immense size. Mr. A. Agassiz gives an account of one that measured seven feet across the disk, and whose appendages stretched out to the length of one hundred and twelve feet; their average size, however, is about one-third the dimensions just given.

The nettling sensation produced by certain Jelly-fishes, when brought in contact with the naked body, has long excited the attention of naturalists. The Cyanea is one of the most formidable in this respect, and Prof. Edward Forbes describes an English species as "the terror of ten-

der-skinned bathers. With its broad, tawny, festooned, and scalloped disk, often a full foot or more across, it flaps its way through the yielding waters, and drags after it a long train of riband-like arms, and seemingly interminable tails, marking its course when the body is far away from us. Once tangled in its trailing 'hair,' the unfortunate, who has recklessly ventured across the graceful monster's path, too soon writhes in prickly torture. Every struggle but binds the poisonous threads more firmly round his body, and then there is no escape; for, when the winder of the fatal net finds his course impeded by the terrified human wrestling in its coils, he, seeking no combat with the mightier biped, casts loose his envenomed arms, and swims away. The amputated weapons, severed from their parent body, vent vengeance on the cause of their destruction, and sting as fiercely as if their original proprietor itself gave the word of attack." Peculiar oval cells, each containing a little filament capable of protrusion, have been supposed to be the seat of this nettling sensation. These are called urticating cells, and the whole class of Jelly-fishes are called *Acalephs*, or Sea-nettles, from this peculiar property. These stinging cells cover the surface of the body and appendages, though, strange enough, there are many species possessing these cells that produce no stinging sensation whatever.

The strangest feature in the history of certain Jelly-fishes belonging to the order Discophoræ, as the Aurelia, for instance, is their wonderful mode of reproduction. It would require too long a time to detail the successive steps made before the whole truth was known regarding the development of these Jelly-fishes. How the successive stages were described by different zoölogists as entirely distinct animals, until at last it was proved that

they all represented the different stages of growth of one animal. The Aurelia, for example, gives origin to little locomotive eggs; these, swimming in shoals, finally effect lodgments on the rocks, one end becoming attached, and the other throwing out little tentacles as in Fig. 1, on Plate 8. In this condition they resemble miniature Polyps. Gradually they increase in length, and little transverse seams, or constrictions, appear on the sides of the body, these constrictions deepening, and their edges becoming scalloped. (See Plate 8, fig. 2.) Finally, the seams have deepened to such an extent that their appearance have been compared to a pile of saucers, and at last they become separated one after the other, each turning upside down, and swimming off free Jelly-fishes. In this stage they are called Ephyra, and are entirely unlike their parent in appearance. By the fall they will have attained their adult form, and a diameter of twelve or more inches.

Figs. 3, 4, on the Plate, represents Ephyras in different stages of growth, a short time after separating from the stalk. In spring time the water is alive with them.

By far the greater number of our smaller Jelly-fishes belong to another order called *Hydroids*, and pass through phases of growth equally as strange as those above recounted. The limits of our paper will allow only a few words on this group. On the rocks at low water, and on floating weed, little moss-like tufts will be found in abundance. This plant-like growth, when examined under a lens, will be seen active with life. The ends of the little twigs and offshoots appear as little bell-shaped cups, with tentacles studding the free ends like the plates of a flower; these are the fixed individuals, and are the purveyors of the community. In the spring time little capsules will be noticed on the twigs, within which are

MORSE ON THE JELLY FISHES.

to be seen minute globular bodies, to be finally set free by the rupture of the capsule, as free swimming Jelly-fishes. (See Plate 8, fig. 12: *a*, fixed individual; *b*, capsule containing young Jelly-fishes.) Others bud directly from the twig and drop off singly, as in *Coryne*. (Fig. 7, buds forming from Hydroid stalk; Fig. 6, adult Coryne.) These are found by thousands in spring time. Not only do these free Jelly-fishes bud from fixed communities, but in one species young ones bud from the Jelly-fish itself, as in *Lizzia* (Fig. 10), and certain others where the young bud from the stomach. All these Hydroid Jelly-fishes produce eggs, which again give rise to plant-like communities. At another time we hope to devote a chapter to the structure of Jelly-fishes, and illustrate more fully the character of the Hydroids, of which we have scarcely touched in this paper.

EXPLANATION OF PLATE 8.

Fig. 1. Early condition of *Aurelia*, — after AGASSIZ.
Fig. 2. Older condition of same, showing individuals about to separate, — after AGASSIZ.
Fig. 3. *Aurelia*, a short time after freeing itself, — original.
Fig. 4. Advanced stage of above, — original.
Fig. 5. *Aurelia*, in adult condition, — after AGASSIZ.
Fig. 6. *Coryne mirabilis* Ag., — original.
Fig. 7. Hydroid community of *Coryne* magnified, showing Jelly-fish buds about to separate, — after CLARK.
Fig. 8. *Pleurobrachia*, — after A. AGASSIZ.
Fig. 9. *Tima formosa* Ag., — original.
Fig. 10. *Lizzia grata* Ag., showing young ones budding from stomach, — original.
Fig. 11. Hydroid community of *Eucope diaphana* Ag., — after A. AGASSIZ.
Fig. 12. Showing one twig of *Eucope* with fixed individual A, and reproductive capsule B, containing a number of young Jelly-fishes, — after A. AGASSIZ.
Fig. 13. *Eucope*, in adult condition, magnified, — original.

AGENCY OF INSECTS IN FERTILIZING PLANTS.

BY W: J. BEAL.

MR. CHARLES DARWIN and other botanists have proved beyond a doubt, that some flowers, in which the pollen may easily gain access to the stigma of the same flower, are sterile unless fertilized by pollen borne from other flowers, while many are much more productive by a cross fertilization.

For information concerning the peculiar manner in which fertilization is effected in the Balsam, Wood-sorrel, Violets, Dicentra or Dielytra, Corydalis, Mitchella or Partridge-berry, Oldenlandia or Houstonia, Primrose, Barberry, Lysimachia or Loosestrife, Orchids, Dutchman's Pipe, and others; consult the observations recorded by Mr. J. T. Rothrock in the second number of the NATURALIST, Mr. Darwin's work on the "Fertilization of Orchids," and seven articles by Dr. A. Gray in the "American Agriculturist," beginning in May, 1866.

With the fact that insects are necessary to fertilize some plants, and the theory that all are improved by crossing, let us see how this is accomplished in plants which may not seem to require the aid of the wind or insects. Plants are very rarely found in which the pollen may not, occasionally at least, get to the stigma of another flower of the same, or an allied species. Then if the pollen is "prepotent" or most effective on stigmas when thus transferred, a cross is very sure to result, even though much pollen comes in contact with the stigma of the same flower. Dr. Gray, acquainted with these facts, and familiar with the structure of the Iris, saw that insects must be needed for the fertilization of this plant also, and without seeing the bees upon them, shrewdly pointed out the manner in which

they must carry the pollen from one flower to another. We verified his theory by observations made two years ago, and found it to be true in the essential particulars.

Without giving a scientific description of the flower, it is enough for our present purpose to say, that the parts consist of three curved tubes, each just about large enough to admit a common honey-bee, being a trifle larger than a cell in her comb.

There is a showy crest, or attractive platform, projecting at the outer end of each tube upon which the bee first alights. When going into the flower for the first time during the day, she is free from pollen. She brushes against a lid which hangs from above, not unlike an old-fashioned swinging door of a cat-hole, as sometimes seen about barns or corn-cribs. When farther in beyond the lid, she comes against the anther, which only discharges pollen on the side next to the bee's back. After getting what nectar she can at the lower end of the tube, she backs out again, pushing the trap-door in the opposite direction. The outside of this door is the only part of the stigma upon which the pollen will produce any effect, so upon visiting the first tube no pollen adheres to the sensitive side of the stigma, although the bee leaves the place with her back well powdered. Calling at another tube, she dives in as before, this time dusting the outside of the lid with pollen which was brought from the tube first visited.

In the early part of June, I examined the common Blue Flag (*Iris versicolor* Linn.) at different times during the day, and always succeeded in seeing the bees at work while their heads and backs contained an abundance of pollen. In wilted flowers, and in some that were fresh, I saw bees occasionally get in and out at the side of the

tube, without touching the stigma at all. Sometimes they went in the tube as first described, and then slipped out at the side instead of backing out. Several went on top of the flower and tried to find other ways to get at the sweets below, but in every instance they failed, and soon left that position.

At the Botanical Garden, Cambridge, Mass., I noticed bees on several foreign species of Iris, in some of which, as *Iris pseudocarus* of Southern Europe, the tube is more nearly perfect, so that it is impossible for them to find a side entrance or egress.

The corolla of *Andromeda floribunda* Pursh, is nearly urn-shaped, hanging with the open end or entrance down. The ten long anthers open at the apex by two round holes, and each anther is supplied with two horizontal or reflexed awns on the outside next the corolla. The stigma is just at the narrow mouth of the corolla. . Bees in abundance visit the flowers, thrusting their long tongue or proboscis against the awns or horns of the anther, as they reach in for nectar which is secreted farther on. By hitting the awns the anthers are disturbed, and the holes brought close against some part of the bee's proboscis, which is well sprinkled over with pollen, as well as the other mouth parts hanging below the flower. Bees were examined, and found to have the parts mentioned covered with the four-grained pollen which is peculiar to a few plants.

I cannot see how pollen alights on the stigmas of this plant, for in falling out in the natural way it must pass by to the ground. But the insect puts the material in place every time as effectually as a mason can stick mortar on the ceiling of a room. The Blueberry (*Vaccinium*) is similar in structure to the *Andromeda*, except that the

awns are wanting. Probably most flowers which droop or hang down are fertilized by insects. For otherwise, how can the pollen find the tip of a stigma, when the style is suspended?

The mode of fertilization in the American Laurel (*Kalmia*) has already been well described in the NATURALIST, but I may be excused for adding my testimony concerning this beautiful and interesting plant.

When the anthers are liberated from the pockets in the corolla, the stamens suddenly straighten and throw jets of pollen often for a foot or more, "acting," as Professor Gray used to say, "like a boy's pea-shooter."

Many times when the dew was on, I have seen the common honey-bee and other *Hymenoptera* about these flowers. When the bee alights on a flower, the style comes up between the legs where they join the body, or sometimes farther back against the abdomen.

In this position they turn around, as though they were balanced on a pivot, generally inserting the tongue outside of the filament, and, while doing this, pull the stamens with their legs towards the centre of the flower, releasing them and frequently receiving the shots of pollen on their own body. A single visit from an insect is sufficient to release all the anthers. By noon it was a difficult matter to find a flower which had not been visited in this way. Insects seem to be absolutely necessary for the perfect fertilization of *Kalmia angustifolia* and *K. latifolia*, for I tied small nets over some flower-clusters (*corymbs*), and found that when the bees were kept away, the flowers withered and fell off, most of the anthers still remaining in the pockets, and the filaments so decayed that their elasticity was entirely gone. The very few an-

thers liberated were probably brought out by the shaking of the bushes by the wind.

Considerable pollen was found stuck on the corollas by the nectar, which was uncommonly abundant, as no insects of much size were allowed to remove it. The wind might have carried some of this pollen to other flowers, or it might have dripped from those above to flowers below in drops of water (there were two showers during these experiments); but I infer this was not the case in the examples mentioned, because the flowers, especially the stigmas, remained fresh much longer than those which were left exposed to the visits of insects.

The flowers of several Honeysuckles, of the Mustard Family (*Cruciferæ*), of the Bladder-nut (*Staphylea trifolia* L.) were noticed, and in each case the conclusion reached was, that the chances are better for cross fertilization than otherwise.

The long cylindrical, bell-shaped corollas of the Purple Foxglove (*Digitalis purpurea*) are much visited by bees. The flowers are mostly obliquely suspended, and in all thus situated, the stamens and style are close to the upper side of the corolla. The insects alight at the opening of the corolla, on the side opposite the stamens. This is generally the lower side as the flowers hang, then reaching above, they catch hold of the style and stamens, and crawl in with the back down, brushing the whole length of the underside of the body, first against the stigma, and, farther on, against the anthers.

They seem unable to get into the flower without catching hold of the stamens, and it is often with considerable difficulty that they enter at all, for they are obliged to hold on to the edge with the hind legs until they can catch the stamens with their fore legs.

In the Evening Primrose (*Oenothera glauca* Michx., *Oe. Missouriensis* and *linearis* Michx.), the stigmas project beyond the anthers, and the flowers vary from an erect to a horizontal position. There are four large stigmas for each style, spreading in the form of a Greek cross.

The pollen, slightly held together by delicate threads, is collected in the morning by great numbers of small wasps, about two-thirds the size of honey-bees. I have often watched them while coming down on, or just over, the stigmas, leaving pollen as they went in, and after collecting what they could, fly out at the side without touching the stigma. On one of these plants, at two different times, a wasp was eagerly trying to pick up the pollen which had been left on the stigmas; the more they tried to collect, the more they scattered pollen about on the glutinous surface, until, as if discouraged or disgusted, they rapidly cleaned their legs of all the tangled mass, and flew away, leaving that cluster of flowers entirely.

In the flowers of the Pea, False Indigo, Yellow-wood (*Cladastris*), Red-bud or Judas-tree, Red and White Clover, Locust, and others of this large and important family (*Leguminosæ*), the anthers surround the stigma, and are closely covered by the corolla. This certainly looks like a very clear case for self-fertilization, but I doubt not the reverse is very often the case. Many of the flowers, as the Pea and Locust, have one petal much larger than the rest, called the standard or banner. Opposite this is another part composed of two petals sometimes united, termed the keel. On this keel bees uniformly alight, and crowd the head down next to the banner-petal. To enable them to do this, they kick the keel and side petals (wings) with their hind legs, and push them back so that the anthers and stigmas

come out from their concealment and meet the underside of the insect where pollen may be left or received. Why the style should be so uniformly curved upward, and all should be brought against the abdomen of insects, I cannot well conceive, unless it be of some use to the plant.

Lupine, another species in this family, has a remarkably long keel which makes a close sheath for the inside parts. On the style, just below the extremity, is a circle of long stiff bristles. As the keel is pushed down, only the stigma, with the bristles below, appears outside, and this pushes out a mass of pollen which generally hits some part of the insect. When left, the flower resumes its former position again.

For about six times pollen can be pushed out in this way, when the supply becomes exhausted. Insects begin on the lowest flowers, and so go up the spike to others which are higher and younger. No experiments have been made on Lupine to show whether it will produce more seeds when visited by insects than when protected.

ICE-MARKS AND ANCIENT GLACIERS IN THE WHITE MOUNTAINS.

BY A. S. PACKARD, JR., M.D.

During a visit last autumn to the White Mountains, we found ice-marks in the valleys of the Saco, Ellis, and Androscoggin Rivers. These grooves, and other signs of ice action, give the clearest evidence, that, during the Glacial Period, the White Mountains were covered by a central *mer-de-glace*, which discharged local glaciers into the principal valleys radiating from the central peaks.

Like the glaciers of the Alps, of the mountains of

Norway, of the Himalaya Mountains, and the mountains of New Zealand, the Andes, and the polar regions at the present day, these rivers of ice flowed down the valleys, like a plastic mass of frozen and refrozen snow and ice. We learn from the writings of geologists that in former times the Alpine glaciers, which now cling to the mountain peaks far up the valleys, descended during a period of great cold, when the Polar Bear, Reindeer, and other arctic animals were spread over Southern Europe, and extended far out upon the broad plains of Italy and Germany. Such must have been the scene in New England during the time of intense cold, known as the Glacial Period. But before theorizing, let us present the facts which seem to us new, and to confirm the opinions that have been before expressed by some of our geologists, that the principal valleys of the White Mountains have been filled with these rivers of ice. Our observations only relate to the eastern part of the mountains.

Let us first explain what is meant by ice-marks or glacial scratches, *striæ*, grooves, and moraines. The rocks and ledges in all the Alpine valleys are grooved and fluted by nearly parallel marks made by gravel and pebbles frozen into the bottom and sides of the slowly-moving mass of ice. The glacier thus grinds down, polishes, and scratches the rocks over which it moves. So steady and uniform is the motion of these immense bodies of ice, that the marks preserve a remarkably uniform course over the uneven surface of the valley. Sometimes a huge ledge projects into the valley. Around this the glacier sweeps, and the marks are curved at this point. Where the glacier debouches on to a broad plain, the ice-marks tend to radiate outwards, fan-like, from the mouth of the valley.

Moraines are formed of the debris or loose refuse matter accumulated either upon the surface, or crowded beneath the ice. The material derived from the latter source forms masses of clay, sand, and rounded stones, the latter of which are often found to be striated on one or more of the sides, like the surface of the solid rock beneath. On the top of the glacier rest long rows or trains of more angular blocks which have fallen from the cliffs above. These windrows of stones are called "lateral moraines," because they are found on each side of the glacier. When such a glacier melts away, a great semicircular heap or hillock of stones and dirt forms what is called a "terminal moraine." We would naturally expect to find the finer, clayey portions with rounded stones, grooved and scratched pebbles, and boulders at the bottom of the rude mass, while the more angular stones would remain upon the top. From the melting of the ice arise rivers whose turbid and swollen waters rush out from beneath the end of the glacier, and further aid in rounding the stones. Such torrential streams are the sources of the Aar, a branch of the Rhine, of the Rhone, and of other rivers which spring out from under the glaciers of the Alps and of Norway.

Our route to the mountains lay up the valley of the Ossipee River, in which Ossipee Lake, Six Mile Pond, and numerous other ponds lie. Looking from the village of Ossipee up the broad valley at the head of which rises the majestic Chicorua, and beholding on all sides lateral moraines thrown up in hillocks of partially stratified gravel and pebbles, and the beautiful glacial lakes embosomed in the gently swelling hills of this delightful valley, it was not difficult to imagine that old Chicorua, in former times, shook off from its icy dome streams of ice

which crowded far up, and even overflowed the sides of this valley, and when all had melted away, left as witnesses of the floods these placid lakes. These sheets of water, however, are not scattered at random over the face of New England. In this valley and the neighboring parts of Maine, they are arranged in a general north-west and south-east course, following that of the rivers. This direction is probably due to the fact that the valleys cut across the general north-east and south-west course of our mountain ranges, which compose the Appalachian chain.

We had no time to search for glacial scratches in the Ossipee valley, but cannot doubt that on examination they will be found pointing towards Mount Chicorua, where, according to Dr. C. T. Jackson,* they follow the general north-west course of this valley.

Riding up the Conway valley, with Kearsarge on our right, and the Mote Mountains on our left, up through Bartlett to Jackson, we observe moraines innumerable rising high up the sides of the valley, and covered with boulders, revealed more distinctly in all the cleared lands. Above these moraines rise rounded and embossed rocks, while the evenly terraced valley, over which the road passes, shows that at a former period (though long after the close of the glacial epoch) the river, then a series of broad lakes, rearranged and resorted the confused materials composing the mounds left by the melting glacier, into finely, evenly stratified fresh-water deposits, which now form the arable land of the plains, over which are scattered the picturesque villages and hamlets so familiar to the White Mountain tourist.

Ice-marks were first noticed at Jackson, on Thorn

* Report on the Geology of New Hampshire.

Mountain, a peak lying just south of Tin Mountain, and estimated by Prof. Guyot to be 2,500 feet high. Here the grooves are well marked, and point directly towards Mount Washington, their course being north 25° west. Even portions of a quartz vein which appears upon the surface is smoothly polished and finely striated. On removing the soil from the surface of the rock a part of the way up the mountain, and also directly upon the summit, these ice-marks could be easily discerned, all running in the same north-west and south-east direction. On Mount Kearsarge, three miles distant, which bears south 25° east from Thorn Mountain, Dr. Jackson states, in the Geology of New Hampshire, that part way up the mountain the drift-marks run north 35° west,—thus pursuing the general north-west and south-east course the valley here assumes. In hastily ascending this mountain on the north side from Jackson, we were not fortunate enough to discover any grooves in the rocks. Half way up the side, however, we found a boulder of a peculiar mica slate, containing large crystals of staurotide, or cross-stone, which must have been borne down on the back of the glacier from Mount Washington, as thick beds of this rock occur near the limit of trees, a little over four thousand feet up that mountain. Similar boulders occurred on some of the hills below.

On an adjoining hill near Goodrich's Falls, are very distinct ice-marks. Here we found a huge angular boulder of many tons weight, which had been apparently detached from the parent rock beneath, and moved a few rods to the south-east; for to the north-west are polished surfaces and grooves which had evidently been made by this large, slowly-moving mass of rock when frozen into the bottom of a glacier. The

surface of the reddish sienite had here been polished smooth as porcelain, as seen in little patches which had survived the centuries of weathering by frosts and snows, which has effaced most of the slighter traces of glacial action in our mountain regions. Here the marks pointed north 30° east. There were also strange marks in the rocks, called *lunoid furrows*, which are crescent-shaped depressions in the rock, with the concavity looking towards the north. The origin of these lunoid furrows have been thus explained. It is known that the glacier is in constant motion, advancing a few inches in summer, and then contracting in winter. Now imagine a stone frozen into the ice, and thus acting as a gouge. Pushed onward and then withdrawn by the powerful hand of the ice-king, it soon wears this peculiar shaped hole, then turns over out of the rut, and catches again in some inequality of the rock, and makes another lunoid furrow, or perhaps a series of four or five, often very regular in form, though the distance between them may vary.

Crossing over the range of mountains north of Mount Kearsarge into Stowe, Maine, we descend into the charming valley of the Cold River. This is a branch of the Saco, and, though now comparatively unknown, it must in future attract many travellers. We pause at the entrance of Evans' Notch, a mountain pass of great interest, and far surpassing Pinkham Notch in grandeur, reminding us rather of the White Mountain Notch. The gate of the pass is guarded on the west by Mount Royce, on the east by Speckled Mountain, whose nine spurs radiate into the towns of Stowe, Albany, and Stoneham. On the broad, flattened, glaciated summit of Speckled Mountain ice-marks abound, pursuing a course north 15°

east, following the course of the valley at this point, and pointing towards a higher peak situated a little to the northward.

In one place a beautiful beryl, in fine crystals of which the coarse granite abounds, has been sliced off by the abrading agent, and polished even with the surface of the feldspar matrix. There are broad surfaces of rock planed down by ice, both on the north-western and north-eastern slopes, showing that the ice must have slid down in both directions from the reservoir of snow which rested on the water-shed between the two valleys. Here, also, occur numerous lunoid furrows, pointing in the same general direction as the straight fine grooves. In the fields, at the bottom of the mountain, are several parallel trains of boulders, formerly lateral moraines, which lie ten or fifteen rods apart. We were informed that these windrows of boulders stop the plough, and it is only possible to turn the sod in the intervals between them, which are entirely free from boulders.

On Mount Baldface, which lies about three miles west of Speckled Mountain, and is composed of a pale fine sienite, with an unusually perfect rift, enabling it to be split into long thin slabs for building purposes, the glacial marks assume quite a different direction, running north 10° to 15° west. On the north-east face, perhaps five hundred feet below the summit, may be seen striæ and lunoid furrows in abundance, running over a smoothly glaciated spur, on which the striæ run north 10° west. Here the lunoids were quite abundant. Some were very large, measuring from one to three feet in diameter.

On the summit of the mountain rest several angular boulders of a peculiar porphyritic sienite, containing

curious oblong crystals of albitic feldspar. Our guide to their source—the trusty ice-grooves—point to Peaked Mountain, a peak lying perhaps half an hour's walk in a direction north 10° west. Under their guidance, and by occasionally following the paths made by bears through the stunted growth of spruce, we find the parent rock from which they had been torn, on the summit of Peaked Mountain, which is composed of this peculiar porphyry.

Passing through Evans' Notch into the valley of the Androscoggin, in the town of Gilead, we find marks on a ledge near the river, which follow a general north-west and south-east direction. This is the general course of the Androscoggin River at this place. Following this river to its mouth, where it empties near the sea-shore into the Kennebec River, the traces of glaciers observed at Bethel, Lewiston, and Brunswick show that a stream of ice once filled the valley throughout its whole length, from the mountains to the sea.

There was also a Peabody River glacier, which joined the Androscoggin glacier, as we may call it, at the junction of those two rivers near the Alpine House, at Gorham, N. H. A geological friend has detected on the north-east side of Mount Washington, on the carriage road, glacial grooves which point down the Peabody valley.

Thus we see the traces of five distinct ancient glaciers, filling as many river valleys, descending from the higher peaks of the White Mountains. In rounding off the tops of the mountains, scooping out the valleys, and levelling with their moraines the deep depressions in the surface of the earth, they were important agents in preparing the way for the advent of man, who should till the soil they

have borne down from the mountains and spread out in fertile plains.

Such are the lessons to be learned of drifted boulders, ice-marks, and moraines. Now looking back through the past, perhaps even hundreds of thousands of years, when an ice-dome capped these mountains, then probably rising much higher above the sea, and sending a glacier down each broad valley into the ocean, where their huge icy cliffs were laved by the waters of a frozen sea, we have to imagine ourself as if on the present coast of Greenland or Spitzbergen, and, looking inland from some mountain peak upon the coast, behold a vast sea of ice with jagged peaks rising up through the broad expanse, cleaving and throwing aside the slowly, imperceptibly moving currents of this inland sea of ice. Near the sea, partly warmed perhaps by the remote influence of the Gulf Stream, whose powers upon the coast of New England were greatly lessened during this period of intense arctic cold, were sunny valleys, carpeted with moss and sprinkled sparingly with lovely arctic flowers,—whose descendants still linger upon the summit of Mount Washington,—half-hidden beneath the snows, or clinging to the cliffs as if shrinking from the icy embrace of the glacier. Here the Reindeer and the Bison* met in herds, the arctic Foxes barked, and the arctic Hare nibbled the short summer's growth; while upon the drifting ice-cakes the Polar Bear sat watching for some stray seal, and the Mammoth, found fossil over the northern part of both hemispheres,

* The teeth of the Walrus and the Bison were discovered by Sir Charles Lyell in the clay-beds at Gardiner, Maine. These are still preserved in a private collection. The association in the glacial clays of the remains of the Bison with those of the Walrus, and the mingling of other arctic animals and plants with those now confined to British North America and New England, show that the climate, during the glacial period, was a little warmer than that of Southern Greenland at present. Though New England was covered with land ice, the climate of the Middle and Southern States, so far as indicated by fossils, did not differ greatly from what it is at present. Even while the Walrus and other arctic animals inhabited New England, the coral reefs of Florida were forming.

stalked over the plains. The Gare Fowl, or Penguin of the north (*Alca impennis*), probably reared its young, fattening them on the Caplin, which has been found fossil in our clay-beds; and the smaller Auks, the Gannet, the Puffin, and Eider Duck filled air and water with their hosts. Through the waves, schools of Narwhales may have disported and waged war with that Bull-dog of the northern seas, the Killer; while the Walrus and Greenland Seal thrust their half-dog, half-human face above the waves, and with angry bark, crowded and jostled each other off the smooth-backed skiers skirting the coast.

Did man gaze upon this scene? Did the forefathers of the Mound Builders or of the ancient Copper Miners of the Great Lakes ply these waters in their kayaks, and build their winter huts of snow amid these arctic scenes?

REVIEWS.

An Inquiry into the Zoölogical relations of the first discovered traces of Fossil Neuropterous Insects in North America; with Remarks on the difference of Structure in the Wings of Living Neuroptera. By *S. H. Scudder*. From the Memoirs of the Boston Society of Natural History. Vol. I. pp. 20, 4to. 1867. With a plate.

The study of the fossil remains of insects is attended with great difficulty. Indeed less is known, perhaps, of the Insect Fauna of former geological periods, than of most other classes of animals, with the exception of the worms and jelly-fishes (*acalephs*). From the fragments of wings, legs, and other hard parts of the insect crust, the fossil entomologist has to reconstruct the insect form of a by-gone period, by comparing these few fragments with their allies of the present day, just as Cuvier restored the quadrupeds of the Paris Basin, delineating their often rude, embryonic forms, from hints afforded simply by pieces of bone and disjointed parts of the skeletons, in some

cases, however, quite complete, discovered by the quarrymen of Montmartre.

The descriptions here given are of the remains of two insects found in the Coal Formation of Morris, Illinois, in company with various coal-plants and amphipod crustaceans, which latter are related to our little beach fleas. These insects were described and figured by Prof. J. D. Dana, in the "American Journal of Science and Arts," in 1864.

Each of the two insects is supposed by the author to form the type of a new family of the Neuroptera, both of which are described and compared with the other families. For such comparisons the author finds the neuration of the wings indispensable as a guide in tracing their affinities, and in limiting the different groups of the Neuroptera generally, of which the Dragon Fly, Forceps-tail, and Ephemera are examples. These two extinct families afford instances of a "synthetic type," a term applied to those animals which combine the characters of other groups, and which are added to their more essential points of differences. An example of the synthetic or comprehensive type is the Garpike, which retains the more essential characters of the fishes, while mimicking the scaly reptiles.

The plates contain partial restorations, one of the right upper wing of *Hemeristia occidentalis*, an insect allied remotely to the Golden-eyed, lace-winged fly, so common in our fields in summer, and the other (*Miamia Bronsoni*) still more distantly, to the gigantic Corydalus, found not uncommonly flying lazily and feebly at twilight in summer.

On the Parallelism between the different stages of Life in the Individual, and those in the entire Group of the Molluscous Order Tetrabranchiata. By *Alpheus Hyatt*. From the Memoirs of the Boston Society of Natural History. Vol. I. Part 2. 1867. pp. 16, 4to.

In this paper, the author makes a comparison between the old age, or period of decline, and the adult forms of allied species of animals, represented at present by the Nautilus and Argonaut. During extreme old age the shell, so to speak, falls into its "second childhood," as stated, though in a more scientific way, by the French naturalist D'Orbigny. This idea is, in the present article, still farther extended to include the collective life of this order of the class of Cephalopods, during the geological periods in which the order came into existence, culminated, and then declined and went out in forms both reminding us of the embryos of the Nautilus, etc., as well as of the earliest generic forms of the order. Thus the different stages of the life of the individual Nautilus or Ammonite accord with the collective life of the entire order.—A. S. P.

American Educational Monthly. — *Devoted to Popular Instruction and Literature.* June, 1867. J. W. Schermerhorn & Co., New York. $1,50 per annum.

This lively and independent monthly does good service in the cause of education. Every number contains an article on Natural History, besides a special department containing gleanings in Science and the Arts. The present number contains valuable hints on the importance of the study of Natural History in Schools.

NATURAL HISTORY MISCELLANY.

BOTANY.

Rottenness of Fruits. — The experiments of M. Devaine, recorded in the "Comptes Rendus," Aug. 20, 1866, prove that the rottenness of fruits is the result of the attacks of fungi, the different varieties in the form of the decay being produced by generic differences in the attacking fungi by the spores of which the fruit has been inoculated. Thus the rottenness determined by a *Mucor* or a *Penicillium* differs in density and color as well as in rapidity of development, and all the other Mucedineæ produce a rottenness so characteristic, that the name of the fungus which produced the mischief may be at once determined; for example, a *Helminthosporium* which attacks the carrot, produces a black putridity; a *Selenosporium?* Corda, which M. Devaine observed upon the cucumber, and which he propagated on this fruit, gives a beautiful red color to the flesh of the cucumber, whilst the rottenness of the same fruit, resulting from the invasion of a Mucor or a Penicillium, has no particular coloration. — *Quarterly Journal of Science.*

ZOÖLOGY.

The Red-legged Grasshopper. — This terrible pest has been for several years immensely destructive in the far West, especially in Kansas, as we learn from a correspondent, who states that it "covered the country last August and September, destroying all the late crops, fall wheat, etc., and deposited its eggs all over the country. Now the farmers are in a quandary, and some are in despair, not sowing or planting, believing that it would be labor spent in vain, while others run the risk." It used to swarm at certain times in the Eastern States. Harris enumerates its visitations in New England in the last century, when it devoured every green thing, so that "days of

fasting and prayer were appointed" on account of the threatened calamity.

How shall the ravages of this well-known grasshopper be stayed? We doubt not that when the West is more thickly settled, and the eggs and young of the grasshopper exposed to the attacks of domestic animals, it will be less abundant.

The habits of this species are not well known, except that they appear in mid-summer in the winged state. The wingless larvæ appear in June, and, as Harris recommends, hay crops should be mown early, before they fly in swarms. The last of summer they couple, and probably lay their eggs in holes in the earth, which are hatched in the spring; at least such are the habits of the common Carolina Locust. As Harris suggests, this insect can only be kept under by concerted action on the part of farmers. "In the south of France the people make a business, at certain seasons of the year (probably in the autumn and late in the spring), of collecting locusts and their eggs, the latter being turned out of the ground in little masses, cemented and covered with a sort of gum, in which they are enveloped by the insects." Various forms of drag-nets can be invented for collecting them in large numbers, and run, if necessary, through a field by horse-power. The inventive genius of our farmers will easily suggest methods of gathering these insects by the bushel, when they can be thrown into hot water, and fed to swine. An entomological friend has found by his own experience, that roasted grasshoppers are excellent eating,—"better than frogs." Only let some enterprising genius of the kitchen once set the example of offering to his customers roasted grasshoppers, rare done, and fricasseed canker-worms,—for we have it on the word of an entomologist that caterpillars are pleasing to the palate of man,—and these droves of entomological beeves will supplant their vertebrate rivals at the shambles, and instead of cattle-fairs, we shall have Grasshopper Festivals, and County Caterpillar Shows.

GEOLOGY.

The Two Earliest Known Races of Men in Europe.—Recent discoveries in archæology, now generally accepted among scientific men, tend to show that man has lived many ages before History gives a hint, either by tradition or written record, of his existence. There are races of fossil men, which have peopled certain areas, and then passed away, their places to be filled by new and strange peoples. Thus the study of prehistoric man belongs with the study of fossil animals and plants, or Palæontology. The life of man upon the earth can only be measured *relatively* in the geological scale, not by recorded

years. Thus Palæontology fades into Archæology, or the study of ancient or prehistoric man; and Archæology graduates into History, which comprises the oral or written accounts of man.

Though the subject is still in a crude state, the conclusions here presented result from the careful observation of facts, now generally received by the soundest geologists and archæologists of the day. The majority of ethnologists agree that man had a common origin, and that his birth-place was in the eastern portion of the old world, whence he has migrated westward. In Europe, where the remains of prehistoric man have been most carefully studied, they have been considered to characterize three periods, or ages, namely: first, the *Stone age*, when stone alone, not metals, was used in the construction of implements; second, the *Bronze age*, characterized by a higher style of art, and the use of implements made for the most part of bronze; and third, the *Iron age*, when such implements of the chase, of war, and domestic life, were constructed largely of iron. Each period is a step towards a higher civilization. From being a simple savage, living singly or in small tribes, without organization, and scarcely able to hold his own against the gigantic wild beasts of those times, we trace, by means of the relics of a slowly forming art, the successive steps of man's intellectual and physical elevation. In all his relations our ideal man, representing the human species as a whole, shows a constant progress upwards.

Races of gigantic mammals, such as the Megatherium, Mammoth, and Mastodon, two species of Rhinoceros, the Cave Bear, Lion, Irish Elk, a large species of Beaver, and the Aurochs, have passed away before his attacks. The rudiments of the art of sculpturing and printing appear at a distinct period, the domestic animals are introduced, the cereals and implements for converting them into food appear, something like national unity binds together hordes of savage men, when History lifts the veil. During this long period of more than Cimmerian darkness, the surface of the earth had undergone great changes. It was probably just emerging from the Glacial Period, when the climate of northern Europe and America was much like that of Greenland at the present day, though the extremes of the climate could not have been so great, it seems to us, as generally stated by European writers. All our rivers ran in much deeper channels, while broad estuaries and chains of lakes covered what are now fertile plains and intervals, dotted with towns and villages. It is safe to say, that man lived as long ago as the Terrace or Lake Period of geologists, on which the Glacial Epoch overlapped.

In an interesting article in the London "Quarterly Journal of Science," by W. B. Hawkins, "On the Habits and Condition of the Two

Earliest Races of Men," the author gives an account of the two races, which succeeded one another during the first, or Stone Period. He states that—

"The gravel-beds of France and England, and the bone caverns of these two countries and of Belgium, have afforded the earliest known traces of man upon the earth. The original discoveries of M. Boucher de Perthes, at Amiens and Abbeville, followed up by the cautious energy of Mr. Prestwich, F. R. S., prove that man coexisted with the fossil mammoth and woolly rhinoceros on the banks of the Somme, at a time when it flowed at a much higher level than at present, and when the relations of hill and valley were altogether different in that district. The labors of the latter, and of Mr. Evans, F. R. S., have resulted in the proof that the same race of men lived in Britain, from Suffolk on the east, as far south as the coast of Hampshire. My own discoveries in Wookey Hole, Hyæna-den, extend their range into Somerset; those of Mr. MacEnery, in Brixham, into Devonshire; and, lastly, those of Dr. Falconer, in Pembrokeshire, into South Wales. Throughout the whole of this area, the same types of flint implements and weapons prevail. A splinter of flint afforded the only cutting edge they possessed; a mass of flint, rudely chipped into a point, was their only boring tool; large, thick, rudely-fashioned 'spear-heads' their principal weapon. The so-called 'sling-stones,' either intended for use as missiles, or imbedded in gum, or bound round with withes, as axes, and some pointed masses of flint which may have been used for digging, comprise the list of their remains from the gravel-beds. . . . The calcined bones on the floor prove that the use of fire was not unknown, and that the cave was inhabited. The evidence afforded by this scant list of the implements and weapons proves that the race of men who used them were savages of the very lowest order, unacquainted with the art of spinning or of making pottery, and living on the fruits of the chase without the aid of the dog. . . . Thus scant is our knowledge of the earliest known men, the Flint Folk par excellence, a race that is as truly fossil and extinct as the Mammoth and Woolly Rhinoceros with whom they lived. To M. Lartet, and the late M. Christy, we owe the proof of the existence of a second race of men in the south of France, in the Department of Dordogne, in the valleys through which flow the Vezere, the Dordogne, and their tributaries. They dwelt in caves and under sheltering rocks, and accumulated around their dwellings the remains of the animals they eat, and vast quantities of the implements and weapons they used. In all the caves and rock-shelters except one, the remains of the Reindeer were most abundant, and evidently constituted the chief food of these savages of the Dordogne, who may therefore be conveniently termed Reindeer Folk, in contradistinction to the Flint Folk described above. The presence of the Mammoth and Cave-lion (the remains of which were few) in the refuse heaps, proves that the age of the Reindeer Folk was that of the great extinct Pachydermata, while the occurrence of the Musk-sheep and Reindeer, animals confined to the cold regions of the north, indicates the arctic nature of the climate at that time in France. The implements are of a higher order, and denote a higher degree of civilization than those of the Flint Folk. . . . The most remarkable remains, however, by far are figures of animals engraved upon stone, antler, bone, or ivory, the earliest traces of sculpture known in western Europe. A slab of schist from Les Eyzies bears the outline of a deer; the lines, however, are too confused for specific identification. The rock-shelter of Laugerie-basse has furnished an outline of the hind quarters of a large ox, boldly and skilfully engraved on the palmated antler of a reindeer. On a second fragment of reindeer antler, the ancient artist has depicted the figure of a horned ruminant, probably the Bouquetin, of which the remains were abundant, and as he had no room to draw the hind legs in their natural position, he doubled them forwards, until the hoofs touched the animal's belly, and thus completed the whole beast. Other fragments of antler, from the same locality, were fashioned into ornamental spoons, or marrow-scoops; and, in one case, a reindeer, kneeling on his forelegs, with eyes, ears, antlers, and tail most distinctly cut, formed the handle of an implement of some kind.

From the rock-shelter of La Madelaine has been obtained most remarkable and unlooked-for evidence of the co-existence of man with the mammoth, in a fragment of fossil ivory, bearing upon it the well-defined figure of the extinct species of Elephant to which it

belonged.* The artist has given to it, not only the tusks with eccentric curvature which are so common in the drift-gravels, but also has marked, in a most unmistakable way, the long hairy mane which we know, from the discovery of the frozen mammoth carcass in the north of Russia, characterized that extinct animal. This specimen, therefore, is most important, not only as an example of the early dawn of art, but also because it stamps the age of the artist to have been that of the Mammoth."

Mr. Dawkins states that the Reindeer Folk seem to have differed from the Flint Folk, "because, although both lived very much under the same physical conditions, in no case are their implements or weapons found together." The implements of the Reindeer Folk indicate a more civilized as well as more modern people, and the small handles of their implements, the similarity of the bone needles, of the marrow-spoons, the habit of carving figures of various animals on bone, etc., and of splitting the bones for the sake of the marrow, and the occurrence of human remains in the refuse heaps of the Reindeer Folk, have caused this fossil race to be compared to the present Esquimaux. It is indeed, as Mr. Dawkins states, not improbable that the Esquimaux, or allied races, formerly ranged as far south as the Alps or Pyrenees.

The differences between these two races are also borne out by other palæontological evidence. With those of the Flint Folk occur remains of the "Sabre-toothed Lion (or Tiger), the Elephas Antiquus, the Hippopotamus, and the Woolly and Leptorine Rhinoceros," which with the exception of the two last, "began to live in the remote epoch called the Pliocene." In the refuse heaps of the Reindeer Folk, however, only two extinct species of mammalia are found, the Irish Elk, and the Mammoth, "both of which sprang into being in the Pleistocene [or Quaternary] period."

"The three animals that especially characterize the Reindeer deposits of Dordogne, as compared with those of the Flint Folk age, are the Antelope Saiga, the Ibex, and the Chamois; of these, the former ranges now through the great central plateau of Asia, the second lives in the Pyrenees, and the last in the Alps."

After these two races had passed away, their soil was occupied in western Europe by a people whom Sir John Lubbock terms Neolithic (*neos*, young; *lithos*, stone). This race invented the use of pottery, and the art of spinning.

"They dwelt in huts, the bottoms of which are now known under the name of hut circles, which are sunk in the earth, or raised on piles driven into the shallows of lakes, as in Switzerland. The tumuli spreading over France, Germany, Britain, and Scandinavia, prove their belief in a future state, as well as their reverence for the dead, whom they buried without burning."

Their implements were elaborated with more skill; they had domesticated the dog, and in the Pile-works of Switzerland are found "the

* Annales des Sciences Naturelles. 5e. ser. t. iv., 6 cahier.

earliest known assemblage of *domestic* animals, the horse, pig, goat, sheep, and ox," and the cakes and seeds found in their dwellings prove that they were acquainted with agriculture. Nearly contemporaneous, or perhaps earlier, lived a similar race in Scandinavia, in whose refuse heaps occur the bones of the Great Auk (*Alca impennis*), which, during this century, has become extinct in Europe and North America, and the Oyster, which they largely fed on, has also disappeared from the Baltic Sea. "The habits of this race were probably similar to the savages of Tierra del Fuego at the present day."

The "Bronze-using Folk arrived in Europe before the dawn of History, and lived there up to the time when history begins. . . . They were acquainted with the use of the potter's wheel, and were in the habit of burning their dead." They used the horse, and had flocks and herds.

The Iron Age came in before the Romans invaded Northern Europe, as they met the Gauls riding in chariots, armed with iron weapons, on the battle-field.

How far these distinctions apply to other countries than Europe, even in the old world, and how far they agree with the very incomplete history of our Aboriginal refuse-heaps, mounds, and relics of American prehistoric races, remains yet to be shown.

MICROSCOPY.

THE VOLVOX AND ITS PARASITE.—In examining with the microscope some specimens of "Volvox globator," one was found containing one of the Rotifera, a female of *Notommata Parasitica* (mentioned by Pritchard as sometimes found in such a situation). When first seen it was feeding, picking out the green masses composing the Volvox, and swallowing them, occasionally shifting its position and selecting a fresh spot. Two eggs had been deposited, and another could be seen in the ovary; they were of a reddish tint, and filled with granules. There was no sign yet of organized structure.

Twenty-four hours after, the Rotifer was dead, but the young could now be plainly seen moving in the eggs, and cilia were in rapid vibration at two distinct points. While still under examination, one of the young broke through the envelope surrounding him, and, after a few energetic struggles, was free and swimming rapidly about the interior of his prison, but did not appear to make any attempt to leave it. The egg-shell or membrane left behind was very delicate and transparent, without dots or markings, the aperture broken off by the animal being plainly visible. The other egg would have soon hatched, as the animal was in active motion within it, but unfortunately the water leaking out

of the live-box containing it, put an end to the observation. The Volvox did not seem disturbed by its strange occupant, but continued its stately revolutions as though they were not present.—B. Webb, Jr.

NATURAL HISTORY CALENDAR.

The Insects of July.—During mid-summer the bees and wasps are very busy building their nests and rearing their young. The Humble-bees, late in June and the first of this month, send out their first broods of workers, and about the middle of the month the second lot of eggs are laid, which produce the smaller-sized females and males, while those eggs laid late in the month and early in August, produce the larger-sized queens, which soon hatch. These hybernate. The habits of their peculiar parasite, *Apathus*, an insect which closely resembles the Humble-bee, are still unknown.

The Leaf-cutter Bee (*Megachile*) may be seen flying about with pieces of rose-leaf, with which she builds, for a period of twenty days, her cells, often thirty in number, using for this purpose, according to Mr. F. W. Putnam's estimate,* at least one thousand pieces! The bees referred to "worked so diligently that they ruined five or six rose-bushes, not leaving a single unblighted leaf uncut, and were then forced to take the leaves of a locust tree as a substitute."

The Paper-making Wasps, of which *Vespa maculata* (Fig. 1), the "White-faced Wasp" is our largest species, are now completing their nests, and feeding their young with flies. The Solitary Wasp (*Odynerus albophaleratus*) fills its earthen cells with minute caterpillars, which it paralyzes with its poisonous sting. A group of mud-cells, each stored with food for the single larva within, we once found concealed in a deserted nest of the American Tent Caterpillar. Numerous species of Wood Wasps (*Crabronidæ*) are engaged in tunnelling the stems of the blackberry, the elder, and syringa, and enlarging and refitting old nail-holes, and burrowing in rotten wood, storing their cells with flies, caterpillars, aphides, and spiders, according to the habit

Fig. 1.

* See Proceedings of the Essex Institute, vol. iv. p. 105.

of each species. *Eumenes fraterna*, which attaches its single, large, thin-walled cell of mud to the stems of plants, is, according to Dr. T. W. Harris, known to store it with canker-worms. *Pelopœus*, the mud-dauber, is now building its earthen cells, plastering them on old rafters and stone-walls.

The Saw-flies (*Tenthredo*), etc., abound in our gardens this month. The *Selandria vitis* attacks the vine, while *Selandria rosæ*, the Rose-slug, injures the rose. The disgusting Pear Slug-worm (*S. cerasi*), often live twenty to thirty on a leaf, eating the parenchyma, or softer tissues, leaving the blighted leaf. The leaves should be sprinkled with a mixture of whale-oil soap and water, in the proportion of two pounds of soap to fifteen gallons of water.

Among the Butterflies, *Melitæa Ismeria*, in the south, and *M. Harrisii*, in the north, is sometimes seen. A second brood of *Colias Philodice*, the common sulphur-yellow butterfly appears, and *Pieris oleracea* visits turnip-patches. It lays its eggs in June on the leaves, and the full-grown, dark green, hairy larva may be found in August. The last of the month a new brood of *Grapta comma* appears, and a second brood of the larva of *Chrysophanus Americanus* may be found on the sorrel.

The larvæ of *Pyrrarctia isabella* hatch out the first week in July, and the snuff-colored moth enters our windows at night, in company with a host of night-flying moths. These large moths, many of which are injurious to crops, are commonly thought to feed on clothes and carpets. The true carpet and clothes moths are minute species, which flutter noiselessly about our apartments. Their narrow, feathery wings are edged with long silken fringes, and almost the slightest touch kills them.

Fig. 2.

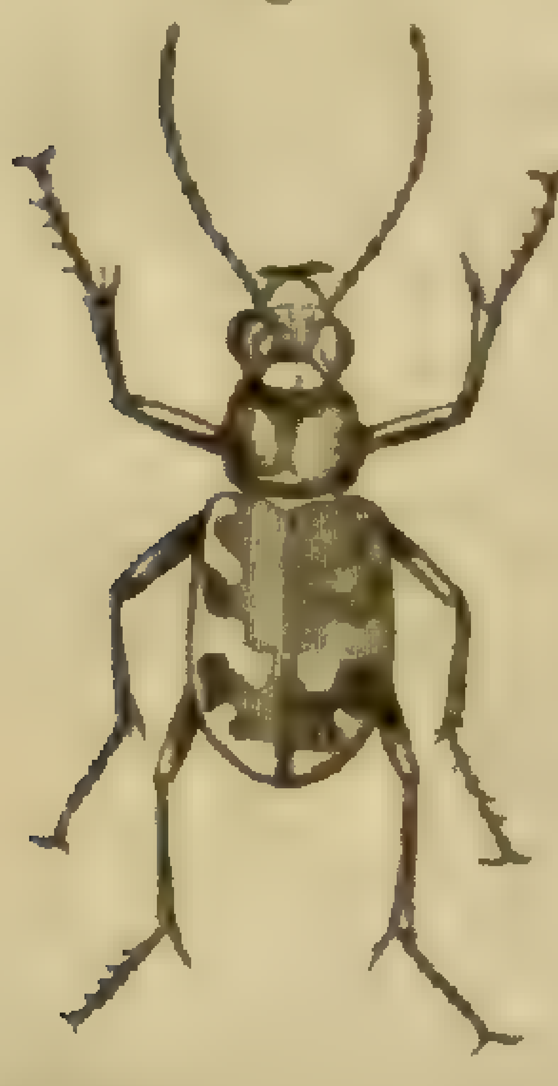
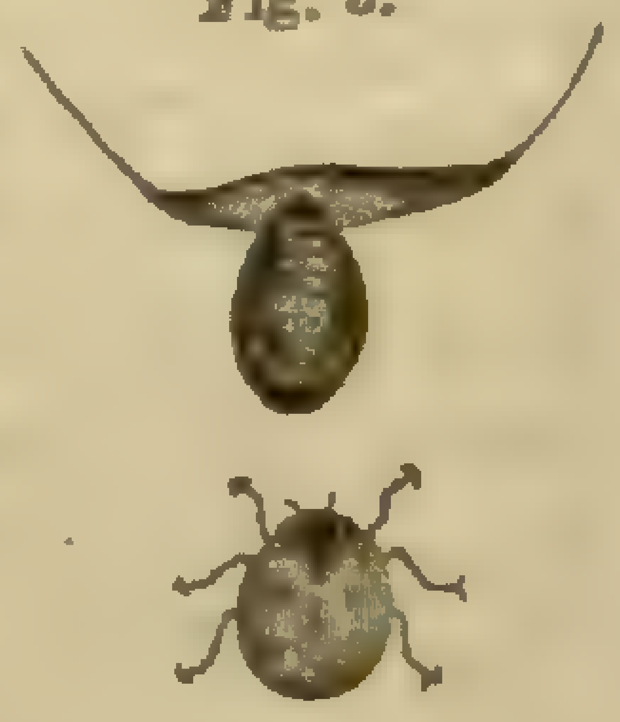


Fig. 3.



Among Beetles, the various borers, such as the *Saperda*, or apple-tree borer, are now pairing, and fly in the hot sun about trees. Nearly each tree has its peculiar enemy, which drives its galleries into the trunk and branches of the tree. Among the Tiger Beetles frequenting sandy places, the large *Cicindela generosa* (Fig. 2), and the *Cicindela hirticollis* are most common. The grotesque larvæ live in deep holes in sand-banks.

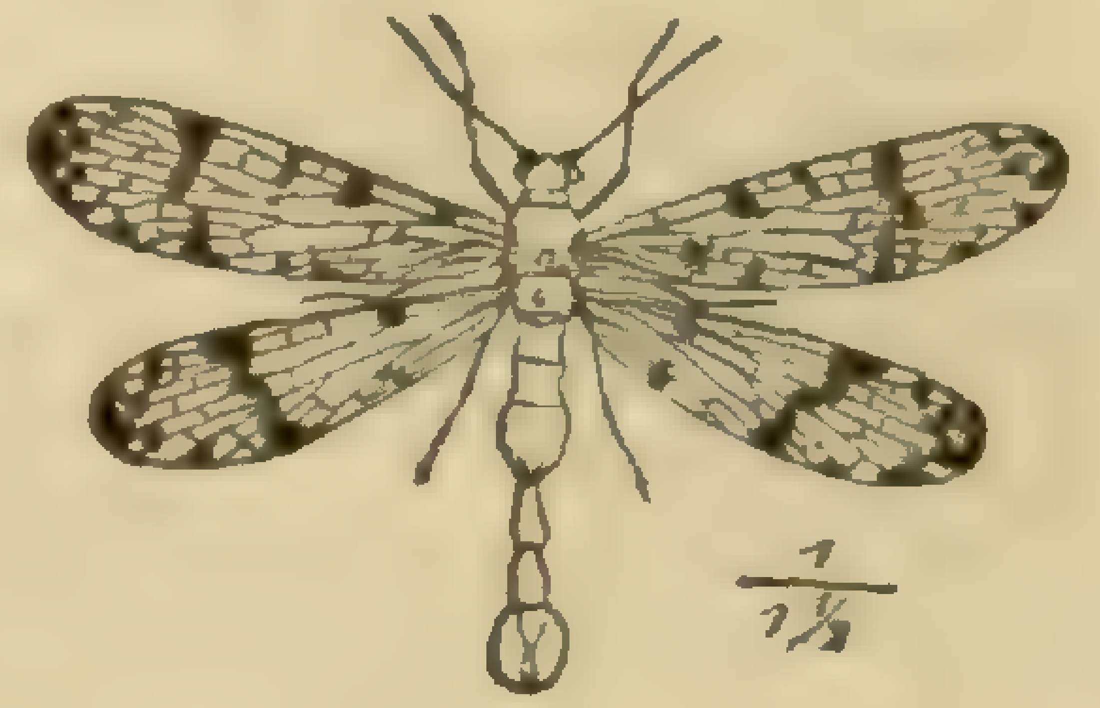
Fig. 4.

The nine-spotted Lady Bug, *Coccinella novemnotata* (Fig. 3, with pupa) is one of a large group of beetles, most beneficial from their habit of

feeding on the plant-lice. We figure* another enemy of the Aphides, *Chrysopa*, and its eggs (Fig. 4), mounted each on a long silken stalk, thus placed above the reach of harm.

Fig. 5.

Fig. 6.



Among other beneficial insects belonging to the Neuroptera, is the immense family of *Libellulidæ*, or Dragon-flies, of which *Diplax Berenice* Drury (Fig. 5), is a fine representative. The Forceps-tail, or Panorpa, *P. rufescens* (Fig. 6), is found in bushy fields and shrubbery. They prey on smaller insects, and the males are armed at the extremity of the body with an enormous forceps-like apparatus.—A. S. P.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA. *March* 19, 1867. Prof. E. D. Cope presented to the Academy a young specimen of the Whale, known as the Bahia Finner, procured near Bahia, Brazil: the length was twenty-one feet. It was shown to belong to the genus *Megaptera* Gray, the Hump-back Whales of sailors.

Dr. Leidy exhibited a number of plates of a forthcoming work on the extinct mammals of Nebraska and Dacota, among which was one representing an almost complete skull of an animal, which he characterized under the name of *Agriochœrus latifrons*.

Prof. Ennis inquired whether remains of the Hippopotamus had been found in this country. Dr. Leidy replied that no evidence existed of the animal, though Mr. J. A. Conrad had at one time a tooth which he considered to have belonged to the Hippopotamus.

April 2.—Mr. Thomas Meehan presented a paper "On Diœcious Forms of Vitis vinifera L." Prof. Ennis remarked upon "the differ-

* The cuts used in this article were kindly allowed to be taken from a Report on the Beneficial Insects of Massachusetts, by Mr. F. G. Sanborn, in the Massachusetts Agricultural Report for 1862.

ent ranges of temperature in the Provinces adjacent to the United States." He also spoke upon "The rise and fall of the floor of the Pacific Ocean, and the resulting geological phenomena."

Boston Society of Natural History. *March* 6, 1867.—Dr. J. C. White exhibited a specimen of Guaranà, moulded into the form of the Jararàca, the most poisonous of Brazilian serpents; it was brought from Brazil by Mrs. Agassiz, and was presented to the Society by Dr. Cotting. The Guaranà is made from the seeds of the *Paullinia sorbilis*, which are roasted, ground, mixed with water, moulded, and dried hard in an oven. It contains a larger quantity of caffine than either tea or coffee, and resembles in appearance common chocolate; dissolved in water it is used as a refreshing drink, and as a remedy for fevers and other ailments. The Manès Indians, who manufacture it, believe it to be more efficacious when made into the form of a serpent, as in the specimen exhibited.

Dr. T. M. Brewer remarked upon the Wood-warblers of North America, a group of birds which unite in a remarkable degree the habits of the tree-creepers with those of the fly-catchers. In some species these habits are alternated as occasion seems to prompt. Some are almost entirely creepers, others almost exclusively fly-catchers. The yellow red-poll warbler is the only one of this group which is known to breed upon the ground, or to be at all terrestrial in habit, by choice; when occasion offers it can be an expert fly-catcher, but when seeking its food on the ground its motion is graceful and easy, showing that the habit is native to the bird, and not assumed by the prompting of necessity.

Entomological Society of Canada. *Toronto, March* 1, 1867.—The Secretary announced that Mr. Saunders, the Curator of the London Branch, was having published for the Society a list of Canadian Coleoptera, which would include about eight hundred species. The meeting then proceeded to the examination and discussion of Canadian *Sphingidæ*, the subject appointed for the evening. The capture, in 1866, of *Philampelus satellitia* Linn., for the first time in Canada, was announced. Dr. Sangster exhibited a number of rare and beautiful specimens, and the Rev. C. J. S. Bethune an undetermined Sphinx captured at Grimsby, C. W. Prof. Hincks made some remarks upon the classification of the *Sphingidæ*, and insects in general, on a "quinary system."

It was resolved, that from May to August, Field Meetings be held on each *second* and *last* Saturday of the month.

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THE QUADRUPEDS OF ARIZONA.

BY DR. ELLIOTT COUES, U. S. A.

THE wild and primitive region which constitutes the Territory of Arizona exhibits a remarkable diversity of surface in its mountain ranges, grassy plains, and desert wastes; and its Fauna and Flora are varied in a corresponding degree. The traveller meets, at each successive day's journey, new and strange objects, which must interest him, if only through the wonder and astonishment they excite. In every department of Natural History there is ample field for observation and study; and even at this late day, opportunities for discoveries in Zoölogy and Botany. First in importance, as they are also in general interest to the observant traveller, are undoubtedly to be ranked the quadrupeds of the country; and so savage and unreclaimed is its condition, that they are there to be seen in what is truly a state of nature. Their habits, and even their numbers have been as yet scarcely subjected to modifying influences by contact with civilization; and he must be stolid indeed, who, under such rarely favorable circumstances, does not look about him

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with interested attention, and learn something of the strange animals by which he is surrounded.

The number of species resident in Arizona is not very great; but nearly all our North American families are represented, and some very fully, which gives to the country its full share of variety in its mammalian forms. At the same time, the individuals of many species occur in multitudes, and constitute marked features of the region in an economic, as well as scientific point of view, from the destructive agency of some, or the value of others as furnishing food and clothing. About seventy species are accredited to the Territory; though this estimate must be regarded as merely approximate, since our most accomplished naturalists are comparatively unfamiliar with the full richness of the Fauna. Of this number, perhaps not more than half are abundant, or from their size, habits, and general importance often brought to the notice of other than professed naturalists. A still larger proportion, though common enough, are very inconspicuous on account of their diminutive size and retiring disposition, and, therefore, are but slightly known. But they should not, on these accounts, be considered less interesting and attractive. The shrew, the mole, the rat, rightly estimated, afford as wide a field for investigation and reflection as the bear, the deer, or the buffalo; and their careful study will as amply repay the naturalist. No single thing in nature is insignificant; nor is there any object incapable of affording both pleasure and instruction to him who will examine with that hearty enthusiasm, and in that true spirit of enlightened inquiry, which should be possessed by one who would call himself a naturalist.

The following pages are prepared mainly from field-notes taken by the writer during his residence in the

Territory. The predominant features of the mammalian Fauna are noticed, and all the species which have fallen under his own observation, or are otherwise known to him as inhabitants of Arizona, are at least alluded to. But the limits of an article like the present necessarily preclude a detailed account of the habits and manners of other than the more characteristic and interesting animals.

Order *Cheiroptera*, the Bats. Of this remarkable and interesting order two groups are represented: one by a single species, the other by numerous forms. The *Istiophora*, or Leaf-nosed Bats, are so called from having a curious membranous expansion of the snout, of a fancied foliaceous appearance, in which the nostrils open. This group is represented by the *Macrotus Californicus*, the Long-eared Bat of California, described and figured by Professor Baird in the Zoölogy of the Mexican Boundary Survey. The type specimen was obtained at Fort Yuma, at the extreme south-west corner of the Territory, and was the first indisputable instance of the occurrence of the group in the United States. I have not met with it personally, and am not aware that any account of its habits has been placed on record.

The other known species of Arizonian Bats belong to the extensive family *Vespertilionidæ*, which is so generally distributed throughout the United States. Perhaps the most interesting species, and one of the commonest, is the Pale Bat (*Antrozous pallidus* Allen), first described by Major Le Conte from California, but now known to range over New Mexico and Arizona. Besides some dental and cranial peculiarities, which separate it generically from *Vespertilio*, its index finger has two phalanges, exhibiting a tendency towards the characters of an en-

tirely different family. This Bat is, as its name indicates, much lighter and paler in color than most of our other species; and it has also a peculiar physiognomy, more repulsive and forbidding than is usual even in this family, none of whose members have remarkably prepossessing features. Its naked muzzle has a peculiar livid hue in life. The species is very abundant at Fort Yuma, where, during the hot months, it becomes a decided nuisance. Numbers take up their abode in the chinks and crannies of the officers' quarters; and the proximity of these retreats actually becomes offensive from the multitudes crowded together. During the daytime a continual scratching and squeaking, as of so many mice, is heard in their retreats, and at night they are even more annoying, by fluttering in scores about the rooms. They are accused of harboring about their bodies quantities of those nocturnal pests, the bed-bugs; but whether justly or not I cannot say. When caught or disabled, they have a harsh squeak; and if incautiously handled, bite with vigor and considerable effect.

The well-known little Brown Bat (*V. subulatus* Say) is generally and abundantly distributed throughout the Territory.

In the Colorado Desert, near Fort Mojave, I procured a small Bat, much like the preceding species; but which my friend Dr. Allen, who kindly examined it, considers as probably a new species, and has named *Vespertilio macropus.** It chiefly differs from *Vespertilio subulatus* in the degree of the attachment of the wing membrane to the foot. When shot, it was industriously capturing insects over a small pool, in broad daylight.

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*In the Proceedings of the Academy of Natural Sciences, Philadelphia, for August, 1866.

Other Arizonian Bats, which I have not personally met with, but give on Dr. Allen's authority, are *Lasiurus cinereus*, *Vespertilio lucifugus*, *V. evotis*, and *V. nitidus*.

Order *Insectivora*, the Insect-eaters. Arizona, so far as is known, is remarkably deficient in small insectivorous mammals, such as the Shrews and Moles. I have never met with a single species, nor am I aware that any have been brought to the notice of naturalists from within the actual limits of the Territory. These animals, however, are very inconspicuous, from their diminutive size, and peculiarly retiring habits; and, therefore, easily escape detection. It is extremely unlikely that none exist; and most probably future investigations will bring to light several species already known from other localities, and some new to science.

Order *Carnivora*, the Flesh-eaters. As might be expected from the unreclaimed condition of the Territory, the native carnivorous animals are still to be found in scarcely diminished numbers. Representatives of all our North American families are furnished, and some of them exist in great abundance.

Of the family *Felidæ*, the Cats, first in size and general consequence, if not in point of numbers, is the Cougar (*Felis concolor* Linn.). With hardly the exception of the Jaguar (*F. onza* Linn.), this is the most powerful of all our digitigrade carnivores. It was formerly distributed quite across the continent, and to high latitudes; but, like most large *Feræ*, it has been gradually driven westward by the progress of civilization, till its occurrence in the East is rare, and only known in the most mountainous and unfrequented regions. Few animals have a greater variety of local names than this one. Its common appellation, "panther," generally becomes "pain-

ter" in the phraseology of backwoodsmen. Its proper English name is probably a modification of "Cuguar," a word which, as suggested by Dr. Schott, may have been formed after the same model as "Jaguar," and bestowed from some fancied resemblance in sound to a common cry of the animal. Another English name is "Puma." The Californians call it "lion," and the Mexicans "leon," and the Apachés "yutin." Though generally distributed, and particularly in the wooded and mountainous portions of the Territory, it is not a very abundant species. During a somewhat protracted residence in the Territory, I never met with one, or heard its peculiarly mournful, though terrifying cry, which has been so fancifully interpreted by different writers. Mr. Audubon doubtless comes nearest the truth, when he ascribes to it a variety of sounds, dependent upon age, sex, season, and other varying circumstances; though nothing to be dignified as a roar has ever been attributed to it. Authors agree better in considering it as a cowardly beast, despite its size and strength; and though there are undoubted instances of unprovoked attacks upon man, these were doubtless made under peculiar exigencies, as when its retreat has been cut off, or the animal was tormented with hunger. That the Indians pursue it successfully with only their bows and arrows I know to be a fact, as I have found skins in their possession cut in various places with the sharp stone points of their arrow-heads.

Two other species of true long-tailed cats may possibly exist, particularly in the south-eastern portions. These are the Ocelot (*F. pardalis* Linn.), and the Jaguar (*F. onza* Linn.). Within the limits of the United States, however, they have as yet only been found in the valley of the Rio Grande of Texas.

A species of Lynx (*L. rufus* var. *maculatus*) is quite abundant. The most obvious external difference between these animals and the true cats is the shortness of the tail; this member being only a few inches in length. They also stand higher for their length, are more heavily built, and have perhaps less of that lithe and supple movement for which the cats proper are so noted; though they are quite as vigorous and muscular. Their ears are often tufted, and one species, at least, has "side-whiskers," formed by the true fur, in addition to the labial bristles which ordinarily receive this name. In dentition they differ in the absence of one upper molar tooth on each side.

Lynxes are very common in the mountainous portions of Arizona. Near Fort Whipple, a small stream is known as "Lynx Creek" from this circumstance; and the animals may often be seen in daylight in that vicinity. A good many are killed by the Indians, who use their beautiful spotted skins for arrow-quivers. A horizontal cut is carried across the buttocks, just under the tail, out of which aperture the animal is withdrawn. The legs are skinned part way down, and the head quite to the eyes and lips. These latter are then sewn up, the legs cut off, or suffered to dangle, the whole hide is dressed softly, and subjected to a lengthwise stretching. After being turned right-side out, it makes an elegant arrow-case, which is slung by a thong, as we would carry a carbine. The Apaché arrows are over three feet in length, and it requires a Lynx's skin, well stretched, to hold them. Besides these quivers, the Indians also make bags and pouches, for a variety of purposes, skinning the animals in the usual way.

In point of numbers, the family *Canidæ*, the Dogs,

stands foremost among the carnivora, though the family is represented by only two species of Wolves, and perhaps as many of Foxes. The word "wolf" is seldom heard in Arizona, even among the whites, who have completely anglicized the Mexican appellations, which are "lobo" for the larger species, and "coyoté" for the smaller. The Spanish for Fox, "zorro," is less frequently used.

Of the many varieties into which the Gray Wolf of America (*Lupus occidentalis* Rich.) runs, I met with but one, the *griseo-albus*, which is perhaps the commonest race throughout the greater portion of the West. The remarkable variations of color, which, though chiefly local, seem to mark races, as they are transmissible from parent to offspring, have caused great confusion among writers, and great uncertainty as to how many species really exist. Wolves may be found from nearly white to pure black, through every gradation of gray, rufous, and dusky; and these diverse colors exist in such varying proportion, and present such an unbroken chain from one extreme to the other, that it seems impossible to consider them as indicating more than remarkable variations to which a single species may be subject, arising from differences in food, climate, and other circumstances.

All the large wolves I saw in Arizona were of the grizzled grayish-white variety. In winter they are very light colored, appearing from a distance almost white; but along the middle of the back, and down the shoulders and flanks, the light color is mixed with slaty or grayish-black. I met with no winter skins showing any brownish or tawny. At this season their pelages were thick and heavy, and a good many of the animals were killed with poison for the sake of the fur, which made very beautiful robes. They were common enough about Fort Whipple,

though shy and wary, and seldom making their appearance by day; and notwithstanding their size and imposing appearance, the part they played was insignificant compared with that of their smaller relatives, the Coyotés.

This latter animal, the Prairie or Barking Wolf (*Canis latrans* Say), is by far the most abundant carnivorous animal in Arizona, as it is also in almost every part of the West. Practically, the Coyoté is a nuisance; theoretically, he compels a certain degree of admiration, viewing his irrepressible positivity of character, and his versatile nature. If his genius has nothing essentially noble or lofty about it, it is undeniable that few animals possess so many, and so various attributes, or act them out with such dogged perseverance. Ever on the alert, and keenly alive to a sense of danger, he yet exhibits the coolest effrontery when his path crosses ours. The main object of his life seems to be the satisfying of a hunger which is always craving; and to this aim all his cunning, impudence, and audacity are mainly directed.

Much has been written concerning the famous polyglot serenades of the Coyoté, by those who have been unwilling listeners; but it is difficult to convey an adequate idea in words, of the noisy confusion. One must have spent an hour or two vainly trying to sleep, before he is in a condition to appreciate the full force of the annoyance. It is a singular fact that the howling of two or three wolves gives an impression that a score are engaged, so many, so long drawn are the notes, and so uninterruptedly are they continued by one individual after another. A short, sharp bark is sounded, followed by several more in quick succession, the time growing faster, and the pitch higher, till they run together into a long-drawn lugubrious howl, in the highest possible key. The same

strain is taken up again and again by different members of the pack, while, from a greater distance, the deep melancholy baying of the more wary lobo breaks in, to add to the discord, till the very leaves of the trees seem quivering to the inharmonious sounds. It is not true, as asserted by some, that the Coyotés howl only just after dark, and at daylight. Though they may be noisiest at these times, when the pack is gathering together for a night's foraging, or dispersing again to their diurnal retreats, I know that they give tongue at any time during the night. They are rarely, if ever, heard in the daytime, though frequently to be seen, at least in secluded regions. Ordinarily, however, they spend the day in quiet, out of the way places, among rocks, in thick copses, etc., and seek their prey mainly by night, collecting for this purpose into packs, as already noticed.

The Coyoté, although a carnivore, is a very indiscriminate feeder, and nothing seems to come amiss, which is capable of being chewed and swallowed. From the nature of the region it inhabits, it is often hard pressed for food, particularly in the winter season. Besides such live game as it can surprise and kill, or overpower by persevering pursuit and force of numbers, it feeds greedily upon all sorts of dead animal matter. To procure this, it resorts in great numbers to the vicinity of settlements, where offal is sure to be found, and surrounds the hunter's camp at night. It is well known to follow for days in the trail of a travelling party, and each morning, just after camp is broken, it rushes in to claim whatever eatable refuse may have been left behind. But it cannot always find a sufficiency of animal food, and is thus made frugivorous and herbivorous. Particularly in the fall, it feeds extensively upon "tunas," which are the juicy, soft, scarlet

fruit of various species of Prickly Pear (*Opuntia*); and in the winter upon berries of various sorts, particularly those of the Juniper (*Juniperus pachyderma*, and others).

Coyotés are so annoying, that a variety of means are employed to destroy them. They may be shot, of course, but to hunt them in the daytime is uncertain, and hardly worth the trouble, while night-shooting is still more laborious and unsatisfactory. Their cunning, inquiring disposition is ordinarily more than a match for man's ingenuity in the way of traps. The most certain, as well as the easiest method of obtaining them, is by poisoning the carcass of a dead animal, or butcher's offal, with strychnine. There is no doubt, also, that the odor of assafœtida is attractive to them, and a little of this drug rubbed into the poisoned meat greatly heightens the chances of their eating it. Since, after taking the poison, they suffer greatly from thirst, it is well to place a tub of water conveniently at hand, which generally keeps them from making off for water, and so being lost. There is considerable difference in the fur, both as to quality and color, according to the season. In the winter it is fuller, thicker, and softer than in summer, and has much less tawny or rufous about it, being almost entirely black and grizzled grayish-white.

Except under certain circumstances, there is a chronic feud between our domestic dogs and these dog-wolves. A good-sized dog will easily whip a Coyoté, though he may not come off unscathed from the sharp teeth and quick snaps of the latter. I have known a smallish terrier even to kill a Coyoté, of which he caught a throat-hold, enabling him by vigorous shakes to beat in the wolf's skull against some boulders between which the conflict took place. Notwithstanding, there is abundant

evidence that the Coyoté will cross and bear fertile offspring with the domestic dog; and I believe the female of either will take the male of the other. During the season of heat, which is in spring, I have known dogs to disappear for several days, and return in such a dilapidated condition as to leave no doubt they had been decoyed away by some female Coyoté, and received hard treatment from her or her relatives. The hybrid is said to possess the bad qualities of both parents, and the good ones of neither, as usual with bastards; and to always remain snappish and intractable, spite of severity or kindness. The gestation of the species, as is well known, does not differ materially from that of its allies. It brings forth in May or June, in secluded places, usually under or among rocks. Five or six puppies are ordinarily produced at a birth. A variety of absurd stories regarding its reproduction pass current, among even the best informed backwoodsmen; many affirming that the pups are born shapeless, inchoate masses, to be afterwards licked into proper shape by the mother.

Among the quite numerous Foxes of North America, but one, the Gray Fox (*Vulpes Virginianus*), is known as an inhabitant of the Territory. Two others, however, the Prairie Fox (*V. macrourus*), and the little Kit or Swift Fox (*V. velox*), may possibly occur. The Gray Fox itself, though generally distributed, does not seem to be abundant. I procured a number of fine skins from the Indians, who use them as articles of dress, for pouches, and a variety of other purposes. I believe they are always skinned in ordinary hunter fashion, by cutting from chin to tail, which latter is left attached, though the greater part of the legs are removed.—*To be continued.*

THE COCKROACH AND ITS ENEMY.

BY G. A. PERKINS, M. D.

THE instinctive habits of insects furnish no small proportion of the interest which attaches to the study of that class of the animal kingdom. The wasps furnish their full share, and the student of nature never tires of investigating the different methods by which they arrive at the same end,—each species following out the law impressed upon it by the Creator with its very being.

The various species of Vespa deposit their eggs in a paper cell, and feed their young, in a larval stage, with insects, which they chew, and partially digest for this purpose. Another genus (*Pompilus*) excavates a hole in the sand in which she deposits numbers of flies, spiders, etc., and with them an egg, and, burying them, leaves the larva to select its own food from these materials. Others, such as *Pelopæus*, the Mud-dauber, places the same materials in curiously constructed cells of clay, and closes them up with the same masonry. Others still, not content with such small game, select the body of one of the larger insects, and deposit in it the germ of their future offspring.

Of this latter class is a beautiful trig little species (*Ampulex Sibirica* Fabr.), very common in Western Africa, and whose polished metallic body, shining like burnished steel, is familiar to all dwellers on that coast. The Ampulex selects the body of the gigantic Cockroach as the receptacle of its egg, and it is not a little amusing to see in what a business-like and determined manner she sets herself to the task of capturing her victim, and serv-

ing her writ of *habeas corpus* upon the doomed roach, full a dozen times her size.

The wasp enters the apartment, and instantly a great commotion takes place among the cockroaches (and their name is legion in the tropics); frantic with fear, they seek a place of greater security, and, in their haste, often rush into the very danger they seek to avoid; for, should the keen eye of the wasp light upon them, the case is a hopeless one. (It is a matter of wonder in what manner the roach should know of the presence of the wasp, and we can only conjecture that its keen perception may distinguish a peculiar sound in the vibrations of the wings of its enemy, as the larger animals are said to in the roaring of the lion.) The wasp flies like a fury at the roach, and a severe struggle takes place; both using legs and wings in the fight, the contest is usually a short one, for the wasp, seizing its victim by the head, or front of the thorax, bends its body short round and plunges its sting into the nearest part, and the roach, who a moment before was fighting for dear life, becomes as quiet as a sleeping infant,—not a leg moves. The victorious wasp draws off a few inches, seeming to survey her vanquished foe with pride, then proceeds to brush off the dust from its brilliant coat and wings, and, after pluming its antennæ, prepares to place its prize in a secluded spot. Taking the roach by the head, she leads him away a few feet, and, leaving him, examines the vicinity for this purpose. In one instance, the cockroach was dragged with considerable trouble between the leaden lining of a tea-chest and the outer box; in another, an open-backed book answered her purpose; but the most singular spot was the inside of a door-lock. The cockroach walked slowly up the door to the key-hole, led by the wasp, and, after

much pulling on the part of the wasp, was forced into the interior. After being out of sight a few minutes, the wasp returned, took several nails from a paper which lay on the floor near by, and carried them, one by one, into the key-hole. I could not but admire the perseverance manifested in this effort. The wasp was obliged to walk backwards up the door to the key-hole; the nail could not be turned by the wasp into a proper position to enter endwise, and, consequently, fell to the floor several times before being successfully drawn in, and each time the wasp descended immediately to renew the attempt. The lock was taken off carefully, and *six four-penny nails* found covering the body of the roach.

Not the least singular feature in the case is, that the sting of the wasp does not kill the cockroach, but only stupefies him, so that the roach, when he walks to his final resting-place, may certainly be said to *go to his own funeral as chief mourner!*

The bodies of this species of cockroach are often found with the empty cocoon of the wasp occupying the cavity of the abdomen; the young wasp, having been hatched there, and, after completing its larval stage, spinning this cocoon, still remains there to complete its development, when it comes forth a perfect insect, in all respects like its parent.

To show with what tenacity the wasp sticks to her prey when once within her grasp, we once put a cockroach, which had been paralyzed, with the wasp, in a glazed earthen pitcher, and watched the result. The wasp attempted to lead the roach out of the pitcher, to which move the cockroach made no objections, and walked up the inclined side of the pitcher as far as his feet would permit him, but not being furnished with the little pads

or suckers with which our common fly and many other insects are provided, he found it out of his power to comply with the requirements of his master, and on attempting to continue his walk, fell to the bottom. The wasp again led him up, and again he fell. This was repeated for the space of three hours, the wasp, in some of her attempts, nearly sustaining the whole weight of the roach. After being convinced of the impossibility of her accomplishing the feat, I liberated the pair, the wasp soon storing her prize away under a bookcase.

FISH CULTURE.

BY CHARLES G. ATKINS.

NEARLY all of our common fishes are *oviparous*, which term, as distinguished from *viviparous*, we may apply to those species of animals which are reproduced by eggs laid in an undeveloped state. In most cases not only are the eggs extruded from the female fish before their development, but also that contact of the male element which impregnates them, and without which no development is possible, is effected after their extrusion.

The operation of spawning, or depositing and impregnating the eggs, as performed by the parent fishes, is essentially as follows. At the spawning season, mature fishes of both sexes repair to a suitable locality; and, having selected a place, the female extrudes her eggs, which sink to the bottom among the pebbles, or, if glutinous, adhere to sticks, weeds, and stones. At the same time, or immediately afterward, the male emits the milt, the fecundating element, which, diffused through the

water, comes in contact with the eggs and impregnates them. In due time, nourished by the water in which they are deposited, and quickened by its heat, they develop and hatch into living fish.

Now a little examination into circumstances will make it evident that a great waste must here occur. A multitude of greedy creatures hover around, ready to devour the eggs as soon as they are left by the parent, or are swept within reach by the current; a portion fails to come in contact with the milt; others are destroyed by noxious sediment or parasitic fungi, or buried deep beneath the shifting sands which the floods may bring down upon them. Should a portion of the eggs escape these dangers, the newly-hatched and defenceless young are eagerly hunted out by all the carnivorous tribes of the water. In the end, comparatively few of the eggs laid result in mature fish; it is perhaps impossible to ascertain the proportion with precision, but one per cent. would be far more than sufficient to maintain and increase the numbers of any species, so enormously fecund are they. Indeed, a rough calculation shows that were one per cent. of the eggs of a salmon to result in full-grown fish, and were they and their progeny to continue to increase in the same ratio, they would in about sixty years amount, in bulk, to many times the size of the earth. Nor is the salmon among the most prolific species. I have counted in a perch (*Perca flavescens*), weighing three and a half ounces, 9,943 eggs; and in a smelt (*Osmerus viridescens*), ten inches in length, 25,141. Some of the larger fishes produce millions at each spawning.

Now if in some way the eggs can be protected from these various dangers that threaten them when abandoned by the parent fish to the ordinary course of nature, it will

at once be seen that a great gain will be made in the number hatched from the spawn of each mother; and if, farther, the young fish can be protected from their enemies until they have acquired size, strength, and agility sufficient to care for themselves, another gain will be thus effected. These two problems are among the most important with which Pisciculture has to deal, but have, we think, been satisfactorily solved.

An interesting experiment was made in Sweden in 1761, by Charles Frederick Lund. He obtained some breams, perch, and mullets, with mature spawn, and placed them in large submerged or floating wooden boxes, in which he had placed quantities of pine boughs. In these boxes the fish were kept several days, until they had completed the process of spawning; they were then removed. The eggs had adhered to the boughs. These species hatch quickly, and in a short time multitudes of young fish emerged from the boughs. In this way he obtained from fifty female breams, 3,100,000 young; from one hundred female perch, 3,215,000 young; and from one hundred female mullets, 4,000,000 young. These are certainly wonderful results. They were placed in the Lake of Ræxen, and dismissed to care for themselves. In a similar way those species, like the trout, whose eggs fall free from each other to the bottom of the stream, may be made to spawn in places where it will be convenient to protect them by enclosures from marauders; and, with a suitable arrangement of small ponds and streams, the young fry of all species may be separated from the old ones that would devour them.

But the crowning discovery in Pisciculture was that of artificial fecundation. This discovery was made during the last century, but was turned to no practical account,

and was hardly practised except in laboratories, when it was re-discovered in France a few years ago, under circumstances that brought its economic bearing prominently before the attention of learned men.

Since the operation of extruding the eggs and milt is essentially mechanical, it can be as well performed by man as by the fish, and, once extruded, the milt performs its own office upon the eggs, and fertilizes them, with no other interference than suffices to bring them into contact. Nay, man can do better than the fish: he can express the eggs into a vessel where none of them will be swept out of reach of the milt, or into the maws of the expectant throng of bystanding fishes; he can then press the milt into the same vessel, and, by stirring them together, insure that the milt shall reach every egg. This is artificial fecundation. But let us examine the method employed.

The operations of Pisciculturists, who have practised artificial impregnation, have been mostly confined to a few species of the family of Salmonidæ. The processes pursued will therefore apply only to a limited extent to the members of other families.

Perhaps salmon and trout have received the most attention. Both these species always seek clear, running, shallow water, and spawn in the autumn or early winter. A female and male, both ripe and ready to spawn, seek a proper place, and on a gravelly bed, swept clean of sand for a small space, the female deposits her eggs, and the male his milt. The operation is described with great minuteness by European writers, but I think that our brook trout (*Salmo fontinalis*) has not been observed sufficiently to ascertain whether its habits are precisely those of the European trout.

All fishes, when spawning, are so intently engaged upon it, that they take very little notice of anything else. Trout can be captured with the greatest ease at this time, —not unfrequently they can be taken with the hand. The following is the artificial process as described by a practical breeder of the brook trout.

The trout, male and female, must be taken with a net, or in some manner that will not injure them, just at the time they are preparing to spawn, and placed in baskets standing in the water in some convenient place. A pan or pail with three or four inches of water in it is brought near the baskets containing the trout. All things being ready, a female trout is taken out of the basket with one hand, and with the other the abdomen is gently rubbed from the gills downward, whereupon the spawn flows in a continuous stream into the vessel. The rubbing is continued until the spawn is wholly extruded, and the trout is then quickly replaced in the water. This operation must not continue more than one minute if possible. On one side of the egg is a small white speck; this is where the impregnation takes place. This side of the egg being lightest, it always falls uppermost. A male trout is now taken, and in like manner the milt is expressed; it falls through the water, and settles upon the eggs. All the trout in the baskets are served in the same manner. The spawn and milt are then placed in shallow vessels, and deposited in water, where they are allowed to remain an hour or more. (Other operators find a few minutes sufficient to insure impregnation, and at the end of that time rinse the eggs thoroughly.)

The manner of proceeding with salmon and other species is essentially the same.

The eggs, being thus artificially impregnated, may be

deposited in a natural stream, under circumstances as closely as possible resembling those chosen by the fish, and left to themselves; or, as is far better, they may be subjected to artificial hatching. By this they may be guarded from various mishaps, the supply of water can be so regulated that it will be uniform, and the eggs can be examined from time to time, and dead and diseased ones be removed before they can injure their neighbors.

It is essential that the incubation be conducted under circumstances like those under which it naturally takes place. The temperature, quality, and state of the water are the main conditions. Some species spawn in fresh water, and some in salt; some in rapid streams, and some in lakes and ponds; some in winter, and some in summer. The temperature required by trout is about forty-one degrees Fahrenheit, ranging, however, from several degrees below this, to about fifty degrees; while some species of summer-spawning fish require a temperature higher than sixty degrees. The time required for development varies with different species, and is much affected by temperature. Some species hatch in five days, while the trout is rarely less than fifty days, and at thirty-seven degrees of heat requires one hundred and thirty-six days.

The apparatus employed in artificial incubation is of various kinds. A metal box, with many holes to admit a free circulation of water, was one of the first employed; this is immersed in the water. Troughs of stone, vessels of earthenware, willow baskets, and wooden boxes have all been used with success in the incubation of salmon and trout.

A favorite form of hatching-box for trout is a long wooden trough, its bottom inclined sufficiently to cause a

gentle flow of water through it, and covered with a layer of gravel; the whole covered in by a lid. The eggs are deposited in the gravel or sand, and a stream of water, an inch or two deep, led through the trough.

At the French Piscicultural establishment at Huningue, and at the Stormontfield salmon-breeding ponds, the hatching apparatus consists of a series of horizontal troughs, arranged side by side like the steps of a stairway, through which a stream of water falls in succession from the uppermost.

After the eggs are deposited in the hatching-boxes, a proper supply of pure water must be kept up until they hatch. They must be frequently examined to remove diseased eggs, and guard against the collection of sediment. It is better that they be kept in darkness, for light encourages the growth of a parasitic fungus.

When trout hatch they have still a large portion of the egg attached to the abdomen; this is gradually absorbed, and while it remains they require no food. It is the "yolk-sack." Upon its complete absorption the young trout begins to feed, and must be placed where he can find his own food, or must be regularly supplied with such as is adapted to his infantile condition, and will attract his attention, and tempt his appetite.

The whole process of producing fish, by artificial impregnation and incubation, is in practice remarkably successful. More than ninety per cent. of the eggs become living fish. Mr. Ainsworth, the authority quoted above, has this year obtained twenty thousand trout from twenty-one thousand eggs, being more than ninety-five per cent.

In another point of view this process is of vast importance. It facilitates the transportation of species from one water to another. Salmon eggs, fecundated, were carried

from Scotland to Australia, in 1865; were successfully hatched in the River Plenty; and, having returned from their first migration to the sea, may now be considered as established there. In a similar manner the Merrimac River has been sown with salmon-eggs brought from New Brunswick, and a harvest may be expected therefrom.

The rearing of fish in artificial ponds and reservoirs, and then bringing them into marketable and eatable condition by regular and systematic feeding, has been successfully carried out, and it is found to be quite practicable as an industrial occupation, bringing better returns, when trout are reared, than the growing of any other kind of animal food. Yet to determine with certainty what are the conditions of success in this branch of Pisciculture requires further experiment.

Pisciculture is not a new art. It was practised among the ancient Romans; yet not as an industrial pursuit, but as a source of amusement to men of wealth and leisure, or to supply with delicacies the tables of a gluttonous nobility. In Catholic countries, since the establishment of monasteries, fish preserves have been commonly attached to those institutions, to supply the devotees with food during their frequent religious fasts. There is no reason, however, to suppose that they had any knowledge of artificial impregnation. In China, it has long been an important branch of industry, and although we know very little of the process that they employ, it is certain that they succeed in making fish an abundant and cheap article of food.

Since the awakening of the public mind to this subject in Europe, government establishments have been put in operation in France and Germany, and private operations of great importance have been carried on in the

British Isles. It is thought that primitive abundance may be restored to their now exhausted rivers, and not many years hence an acre of water shall be made to produce as much food for man as an acre of land. In America many persons have engaged in pisciculture as an experiment, and some attempts have been made to carry it farther; but as nothing has been done on a large scale, no great results have yet been attained.

THE DRAGON-FLY.

PLATE 9.

BY A. S. PACKARD, JR., M. D.

Were we to select from among the insects a type of all that is savage, relentless, and bloodthirsty, the Dragon-fly would be our choice. From the moment of its birth until its death, usually a twelve-month, it riots in blood-shed and carnage. Living beneath the waters perhaps eleven months of its life, in the larva and pupa states, it is literally a walking pitfall for luckless aquatic insects; but when transformed into a fly, ever on the wing in pursuit of its prey, it throws off all concealment, and reveals the more unblushingly its rapacious character.

Not only does its horrid visage and ferocious bearing frighten children, who call it the "Devil's Darning-needle," but it even distresses older persons, so that its name has become a byword. Could we understand the language of insects, what tales of horror would be revealed! What traditions, sagas, fables, and myths must adorn the annals of animal life regarding this Dragon among insects!

Fig. 2.

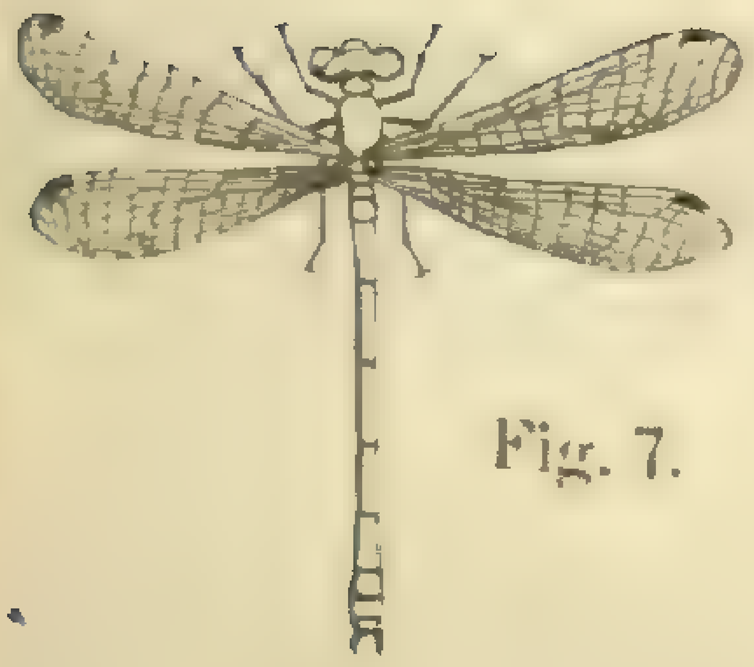


Fig. 7.

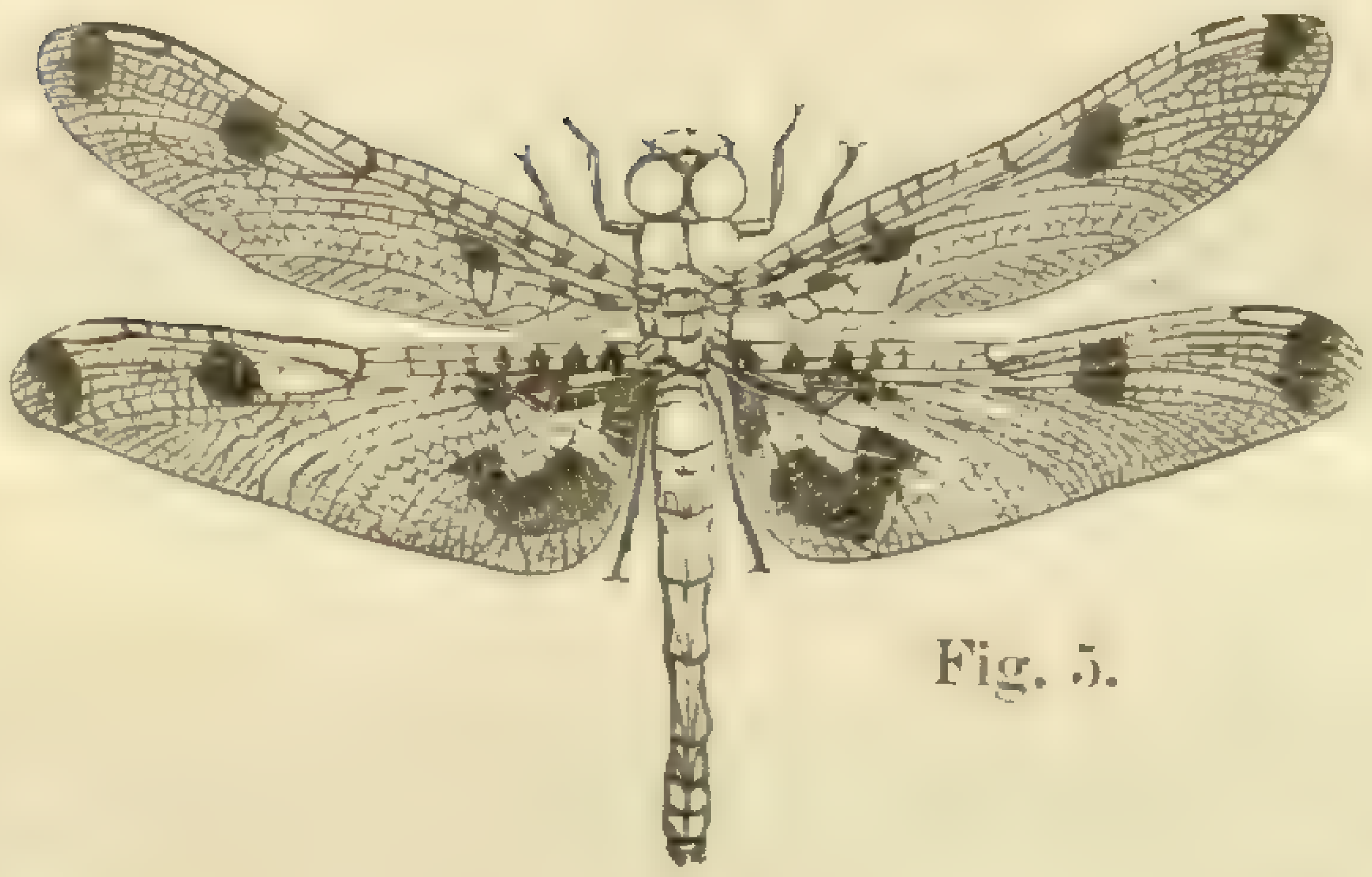


Fig. 5.

Fig. 6.

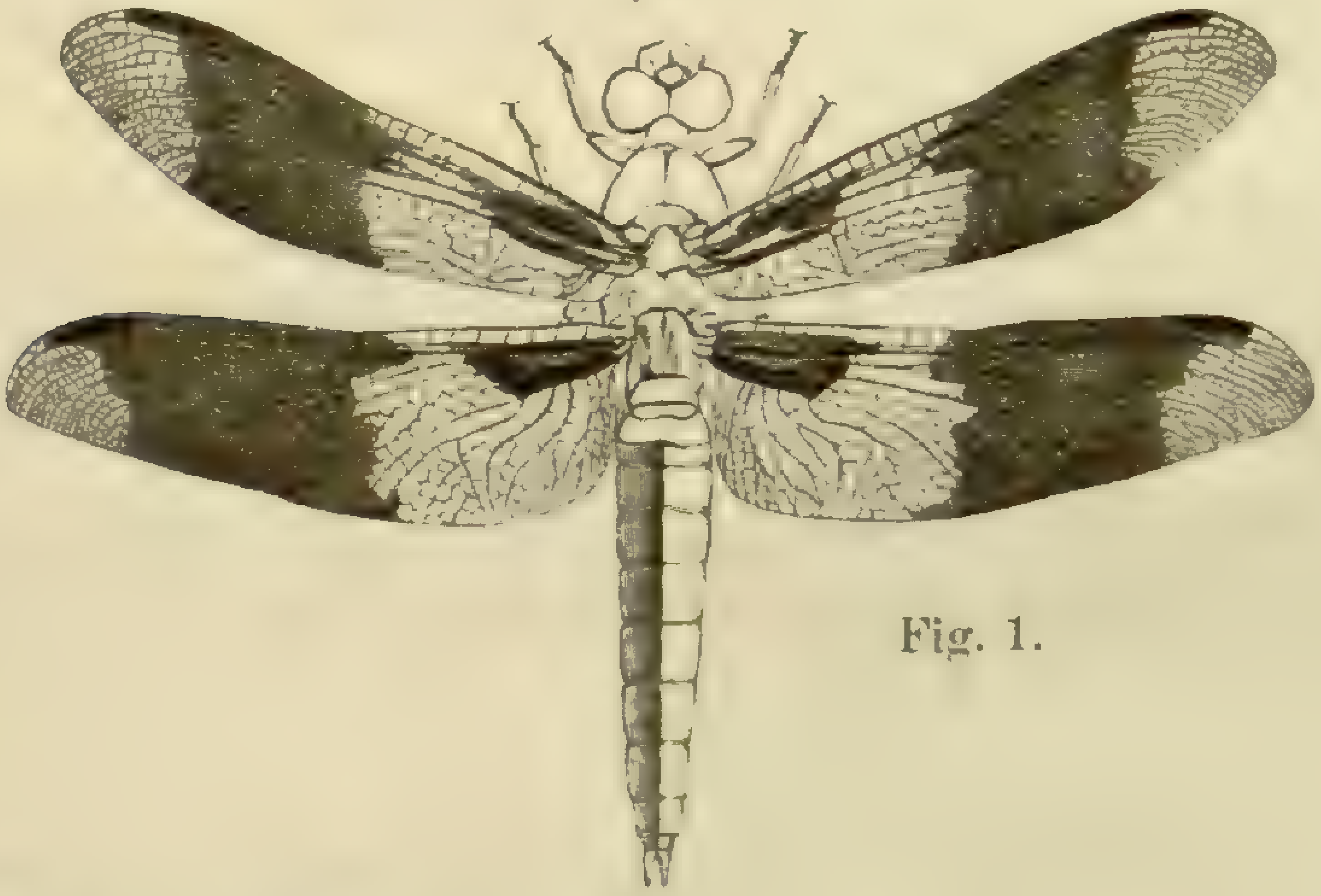


Fig. 1.

Fig. 3.

Fig. 4.

PACKARD ON THE DRAGON FLY.

To man, however, aside from its bad name and its repulsive aspect, which its gay trappings do not conceal, its whole life is beneficent. It is a scavenger, being like that class ugly and repulsive, and holding literally, among insects, the lowest rank in society. In the water, it preys upon young musquitoes and the larvæ of other noxious insects. It thus aids in maintaining the balance of life, and cleanses the swamps of miasmata, thus purifying the air we breathe. During its existence of three or four weeks above the waters, its whole life is a continued good to man. It hawks over pools and fields and through gardens, decimating swarms of musquitoes, flies, gnats, and other baneful insects. It is a true Malthus' delight, and, following that sanguinary philosopher, we may believe that our Dragon-fly is an entomological Tamerlane or Napoleon sent into the world by a kind Providence to prevent too close a jostling among the myriads of insect life.

We will, then, conquer our repugnance to its ugly looks and savage mien, and contemplate the hideous monstrosity,—as it is useless to deny that it combines the graces of the Hunchback of Notre Dame and Dickens' Quilp, with certain features of its own,—for the good it does in Nature.

Even among insects, a class replete with forms the very incarnation of ugliness and the perfection of all that is hideous in nature, our Dragon-fly is most conspicuous. Look at its enormous head, with its beetling brows, retreating face, and heavy under jaws,—all eyes and teeth,—and hung so loosely on its short, weak neck, sunk beneath its enormous hunchback,—for it is wofully round-shouldered,—while its long thin legs, shrunken as if from disease, are drawn up beneath its breast, since our fiend of the air is a poor pedestrian.

Its gleaming wings are, however, beautiful objects. They form a broad expanse of delicate parchment-like membrane drawn over an intricate network of veins. Though the body is bulky, it is yet light, and easily sustained by the wings. The long tail undoubtedly acts as a rudder to steady its flight.

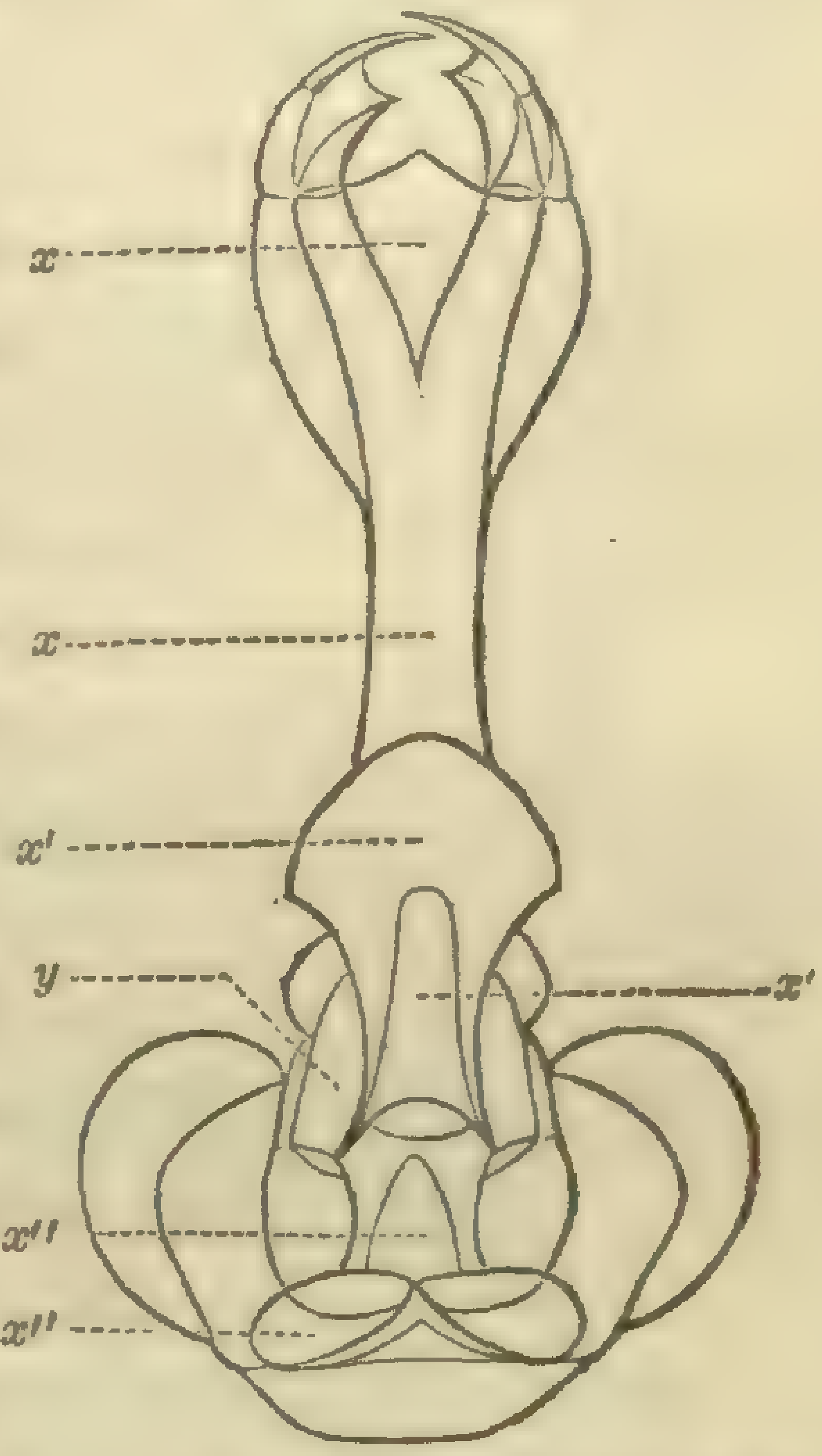
These insects are almost universally dressed in the gayest colors. The body is variously banded with rich shades of blue, green, and yellow, and the wings give off the most beautiful iridescent and metallic reflections.

During this month, the various species of Libellula and its allies most abound. The eggs are attached loosely in bunches to the stems of rushes and other water-plants. In laying them, the Dragon-fly, according to Mr. P. R. Uhler's observations, "alights upon water-plants, and, pushing the end of her body below the surface of the water, glues a bunch of eggs to the submerged stem or leaf. *Libellula auripennis*, I have often seen laying eggs, and I think I was not deceived in my observation that she dropped a bunch of eggs into the open ditch while balancing herself just a little way above the surface of the water. I have, also, seen her settled upon the reeds in brackish water with her abdomen submerged in part, and there attaching a cluster of eggs. I feel pretty sure that *L. auripennis* does not always deposit the whole of her eggs at one time, as I have seen her attach a cluster of not more than a dozen small yellow eggs. There must be more than one hundred eggs in one of the large bunches. The eggs of some of the Agrions are bright apple-green, but I cannot be sure that I have ever seen them in the very act of oviposition. They have curious habits of settling upon leaves and grass growing in the water, and often allow their abdomens to fall below the surface of the

water; sometimes they fly against the surface, but I never saw what I could assert to be the projecting of the eggs from the body upon plants or into the water. The English entomologists assert that the female Agrion goes below the surface to a depth of several inches to deposit eggs upon the submerged stems of plants." The Agrions, however, according to Lucaze Duthiers, a French anatomist, make, with the ovipositor, a little notch in the plant upon which they lay their eggs.

These eggs soon hatch, probably during the heat of summer. The larva is very active in its habits, being provided with six legs, attached to the thorax, on the back of which are the little wing-pads, or rudimentary wings. The large head is provided with enormous eyes, while a pair of simple, minute eyelets (*ocelli*) are placed near the origin of the small bristle-like feelers, or antennæ. Seen from beneath, instead of the formidable array of jaws and accessory organs commonly observed in most carnivorous larvæ, we see nothing but a broad, smooth mask covering the lower part of the face; as if from sheer modesty our young Dragon-fly was endeavoring to conceal a gape. But wait a moment. Some unwary insect comes within striking distance. The battery of jaws is unmasked, and opens upon the victim. This mask (Fig. 1) is peculiar to the young, or larva and pupa

Fig. 1.



Under side of head of *Diplax*, with the labium or mask fully extended. x, x', x'', the three subdivisions of the labium. y, the maxillæ, or second pair of jaws.

of the Dragon-fly. It is the labium, or under lip greatly enlarged, and armed at the broad spoon-shaped extremity (Fig. 1, x) with two sharp hooks, adapted for seizing and retaining its prey. At rest, the terminal half is so bent up as to conceal the face, and thus the creature crawls about, to all appearance, the most innocent and lamb-like of insects.

Not only does the immature Dragon-fly walk over the bottom of the pool or stream it inhabits, but it can also leap for a considerable distance, and by a most curious contrivance. By a syringe-like apparatus lodged in the end of the body, it discharges a stream of water for a distance of two or three inches behind it, thus propelling the insect forwards. This apparatus combines the functions of locomotion and respiration. There are, as usual, two breathing pores (*stigmata*) on each side of the thorax. But the process of breathing seems to be mostly carried on in the tail. The tracheæ are here collected in a large mass, sending their branches into folds of membrane lining the end of the alimentary canal, and which act like a piston to force out the water. The entrance to the canal is protected by three to five triangular horny valves (Fig. 2, 9, 10, 2 *a*, side view, 2 *b*), which open and shut at will. When open, the water flows in, bathing the internal gill-like organs, which extract the air from the water. This is then suddenly expelled by a strong muscular effort.

Fig. 2.

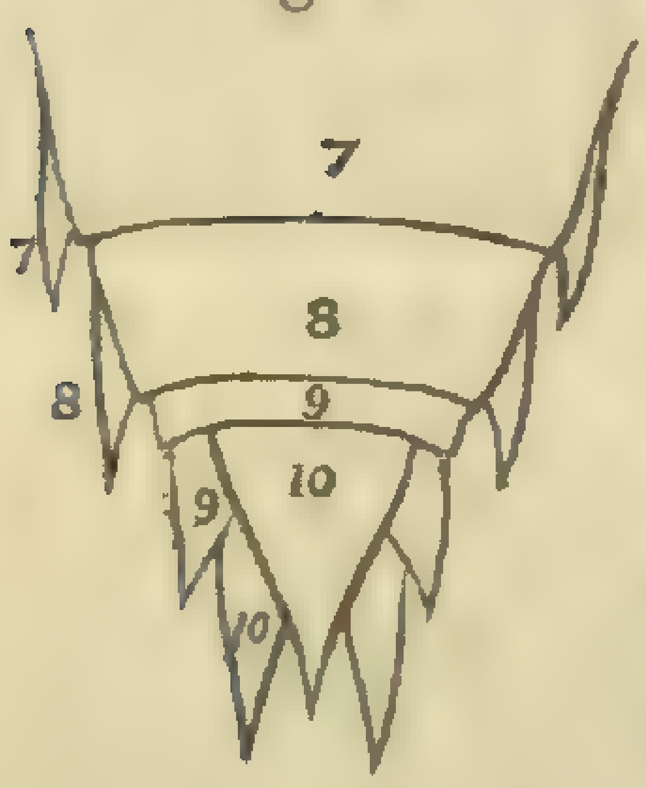


Fig. 2 *a*.

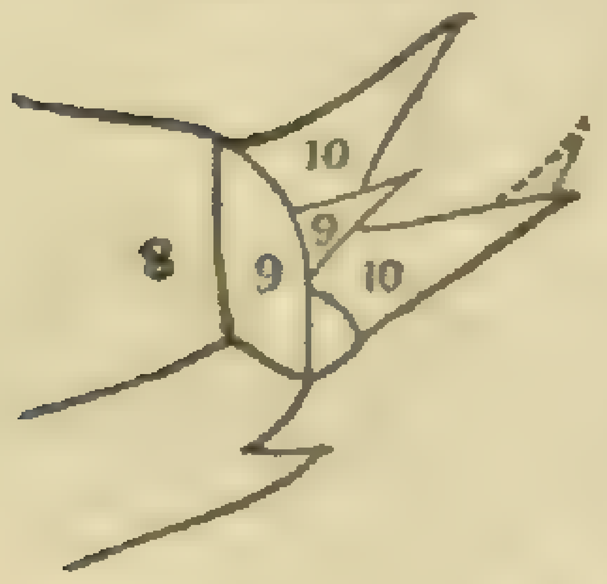
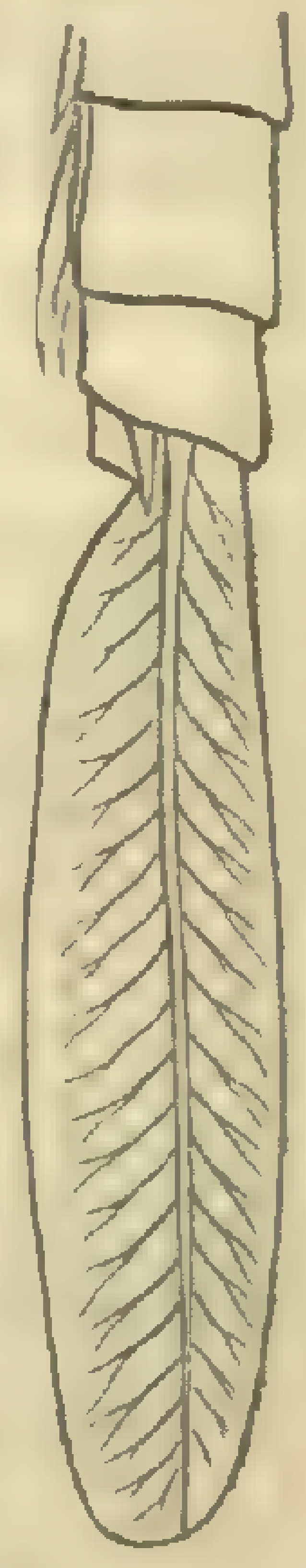


Fig. 2 *b*.



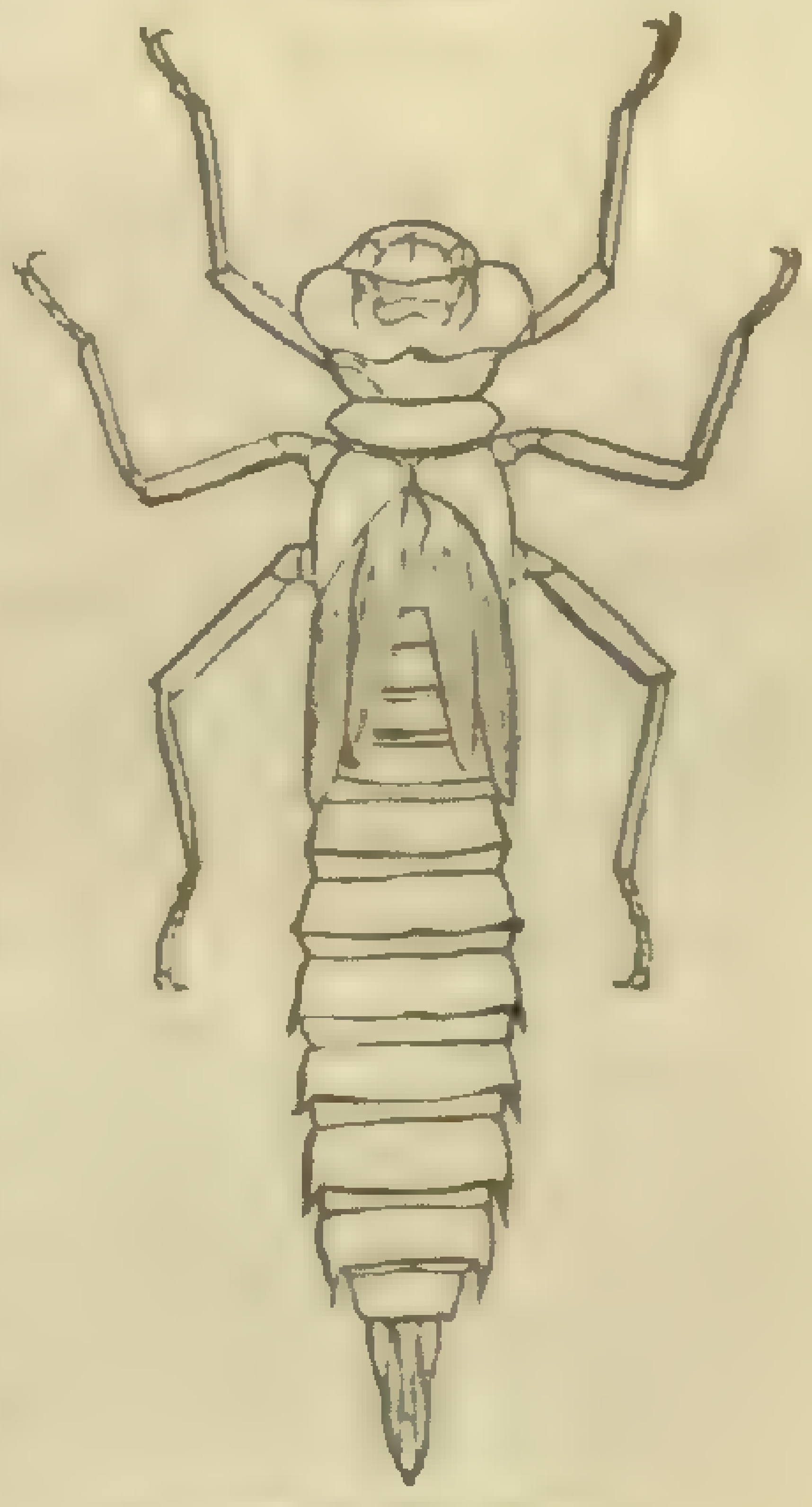
In the smaller genera, *Agrion* (*A. saucium*, Plate 9, fig.

7. Fig. 2 *b*, side view of false-gill, showing but one leaf), *Lestes* and *Calopteryx*, the respiratory leaves, called the tracheary, or false-gills, are not enclosed within the body, but form three broad leaves, permeated by tracheæ, or air-vessels. They are not true gills, however, as the blood is not aerated in them. They only absorb air to supply the tracheæ, which aerate the blood only within the general cavity of the body. These false-gills also act as a rudder to aid the insect in swimming.

It is easy to watch the Dragon-flies through their transformations, as they can easily be kept in aquaria. Little, almost nothing, is known regarding their habits, and any one who can spend the necessary time and patience in rearing them, so as to trace up the different stages from the larva to the adult fly, and describe and figure them accurately, will do good service to science.

Mr. Uhler states that at present we know but little of the young stages of our species, but "the larva and pupa of the *Libellulidæ* may be always known from the *Æschnidæ* by the shorter, deeper, and more robust form, and generally by their thick clothing of hair."

Fig. 3.



Pupa of Æschna.

The pupa scarcely differs from the larva, except in having larger wing-pads (Fig. 3). It is still active, and as much of a gourmand as ever. When the insect is about to assume the pupa state, it moults its skin. The body having outgrown the larva skin, by a strong muscular effort a rent opens along the back of the thorax, and the insect, having fastened its claws into some object at the bottom of the

pool, the pupa gradually works its way out of the larva-skin. It is now considerably larger than before. Immediately after this tedious operation, its body is soft, but the crust soon hardens. This change, with most species, probably occurs early in summer.

When about to change into the adult fly, the pupa climbs up some plant near the surface of the water. Again its back yawns wide open, and from the rent our Dragon-fly slowly emerges. For an hour or more, it remains torpid and listless, with its flabby, soft wings remaining motionless. The fluids leave the surface, the crust hardens and dries, rich and varied tints appear, and our Dragon-fly rises into its new world of light and sunshine a gorgeous, but repulsive being. Tennyson thus describes these changes in "The Two Voices":—

> To-day I saw the Dragon-fly
> Come from the wells where he did lie.
> An inner impulse rent the veil
> Of his old husk: from head to tail
> Came out clear plates of sapphire mail.
>
> He dried his wings; like gauze they grew;
> Through crofts and pastures wet with dew
> A living flash of light he flew.

Of our more common, typical forms of Dragon-flies, we figure a few, commonly observed during the summer. *Libellula trimaculata* of Count De Geer, a Swedish entomologist, of which Fig. 1, Plate 9, represents the male, is so-called from the three dark clouds on the wings of the female. But the opposite sex differs in having a dark patch at the front edge of the wings, and a single broad cloud just beyond the middle of the wing.

Libellula quadrimaculata (Fig. 2, Plate 9), the four-spotted Dragon-fly, is seen on the wing in June, flying through dry pine woods.

The largest of our Dragon-flies are the "Devil's Darning-

needles," *Æschna heros* and *grandis*, seen hawking about our gardens till dusk. They frequently enter houses, carrying dismay and terror among the children. The hind-body is long and cylindrical, and gaily colored with bright green and bluish bands and spots.

Mr. Uhler informs us that the pupa of *Æschna*, figured above, from a drawing by Mr. F. G. Sanborn, is perhaps that of *Æschna constricta*, or *Æ. clepsydra*.

One of our most common Dragon-flies is *Diplax rubicundula*, the ruby Dragon-fly, which is yellowish red. It is seen everywhere flying over pools, and also frequents dry sunny woods and glades. Another common form is *Diplax Berenice* of Drury (Plate 9, Fig. 3 male, Fig. 4 female. The accompanying cut represents the pupa, probably of this species, according to Mr. Uhler.) It is black, the head blue in front, spotted with yellow, while the thorax and abdomen is striped with yellow. There are fewer stripes on the body of the male, which has only four large yellow spots on each side of the abdomen. Still another pretty species is *Diplax Elisa* of Dr. Hagen (Plate 9, Fig. 5). It is black, with the head yellowish and with greenish yellow spots on the sides of the thorax and base of the abdomen. There are three dusky spots on the front edge of each wing, and a large cloud at the base of the hind pair toward the hind angles of the wing.

Fig. 4.

Pupa of *Diplax*.

Rather a rare form, and of much smaller stature is the *Nannophya bella* of Uhler (Fig. 6, female). It was first detected in Baltimore, and we afterwards found it not unfrequently by a pond in Maine. Its abdomen is unusually short, and the reticulations of the wings are large and simple. The female is black, while the male is frosted over with a whitish powder. Many more species

of this family are found in this country, and for descriptions of them we would refer the reader to Dr. Hagen's Synopsis of the Neuroptera of North America, published by the Smithsonian Institution.

The Libellulidæ, or family of Dragon-flies, and the Ephemeridæ, or May-flies, one of which is figured in our second number, are the most characteristic of the Neuroptera, or veiny-winged insects.. This group is a most interesting one to the systematist, as it is composed of so many heterogeneous forms which it is almost impossible to classify in our rigid and at present necessarily artificial systems. We divide them into families and sub-families, genera and sub-genera, species and varieties, but there is an endless shifting of characters in these groups. The different groups would seem well limited after studying certain forms, when to the systematist's sorrow here comes a creature, perhaps mimicking an ant, or aphis, or other sort of bug, or even a butterfly, and for which they would be readily mistaken by the uninitiated. Bibliographers have gone mad over books that could not be classified. Imagine the despair of an insect-hunter and entomophile, as he sits down to his box of dried neuroptera. He seeks for a true neuropter in the white ant before him, but its very form and habits summons up a swarm of true ants; and then the little wingless book-louse (*Atropos*) scampering irreverently over the musty pages of his *Systema Naturæ*, reminds him of that closest friend of man—*Pediculus vestimenti*. Again, his studies lead him to that gorgeous inhabitant of the Mediterranean shores, the butterfly-like *Ascalaphus*, with its gorgeous wings, and slender, knobbed antennæ so much like those of butterflies, and visions of these beautiful insects fill his mind's eye; or sundry dun-colored caddis flies, modest,

delicate neuroptera, with finely fringed wings and slender feelers, create doubts as to whether they are not really allies of the clothes moth, so close is the resemblance.

Thus the student is constantly led astray by the wanton freaks Nature plays, and becomes sceptical as regards the truth of a natural system, though there is one to be discovered; and at last disgusted with the stiff and arbitrary systems of our books,—a disgust we confess most wholesome, if it only lead him into a closer communion with nature. The sooner one leaves those maternal apron-strings,—books,—and learns to identify himself with nature, and thus goes out of himself to affiliate with the spirit of the scene or object before him,—or, in other words, cultivates habits of the closest observation and most patient reflection,—be he painter or poet, philosopher or an insect-hunter of low degree, he will gain an intellectual strength and power of interpreting nature, that is the gift of true genius.

THE LAND SNAILS OF NEW ENGLAND.

BY EDWARD S. MORSE.

(Continued from page 188.)

THE snails thus far described represent a natural group having, generally, a stout, heavy shell, and usually a reflected lip to the aperture. The jaw is heavily ribbed, and the teeth are short, and, on the extreme border of the membrane, serrated. The jaw and teeth of *Helix albolabris*, figured in the first number of the NATURALIST, represents well like characters of the group. The species now to be considered have smooth or polished shells, the

lip simple or sharp, and the teeth are claw-shaped; the jaw being devoid of ribs, having, however, a central projection, as shown in Fig. 19,—(jaw of *Helix inornata.*)

VITRINA LIMPIDA *Gould.* (Fig. 20.) Shell globular, very thin and fragile, transparent and shining. Whorls two to three, the last, or body whorl, very large and expanded; no umbilicus; diameter nearly one-fourth of an inch. Animal greyish, or nearly black, and large compared to the size of the shell. The mantle extends from the aperture of the shell covering the back of the animal to the base of the tentacles, a portion extending backward covering the spire. The animal is always very moist, and appears covered with water.

Fig. 19.

Fig. 20.

This species is probably carnivorous in its habits, as in confinement it has been noticed to feed on dead and even live earth-worms, while vegetable food has been rejected. It has been found in northern Vermont, in northern Maine, and near Portland, Me., quite abundant. Outside of the limits of New England this species occurs in the North-western Territory, and the northern parts of the United States bordering on Canada. It is generally found in open ground or low underbrush in damp places.

HELIX INORNATA *Say.* (Figs. 21, 22.) Shell depressed, yellowish horn-color, smooth and shining. Whorls five; lip simple and sharp, the lower part reaching to the umbilicus, which is small. Within the lip there is a thick, white shelly deposit which tends to strengthen the fragile aperture. Diameter of shell less than three-fourths of an inch. Animal bluish black, disk whitish. At the termination of the tail there is a gland from which the mucus pours freely when the animal is in motion.

Figs. 21, 22.

This shell is recorded as being found in Vermont by Professor Adams, though it cannot properly be regarded as a New England species. It is common at the West.

HELIX FULIGINOSIS *Binney*. (Figs. 23, 24.) Shell thin, flattened above, nearly chestnut-color, sometimes a greenish horn-color. Whorls four and a half; last whorl very large, suture slightly indicated. Aperture large, nearly circular, within pearly. Lip simple, brittle, slightly thickened within by a testaceous deposit. Umbilicus not large. Diameter an inch or more. Animal blackish, or bluish black. On the tail there is a slit from which the mucus pours freely. This shell resembles somewhat that of *Helix inornata*, but differs in being much larger, and always having one whorl less. The umbilicus is larger, and the aperture is more circular.

Figs. 23, 24.

This species occurs in nearly all the States east of the Rocky Mountains. It is extremely rare in New England, having been found only in the extreme western limits.

Of the species thus far described in these papers, only three of them can be considered as really common in New England, namely, *Helix albolabris*, *monodon*, and *alternata*. The others are rarely to be met with. It is difficult for the collector to obtain more than ten or twelve specimens of the larger species in a day's ramble, though at the West they may be found by hundreds. The cause of this disparity in numbers is attributed to the abundance of limerock at the West; this rock favoring the multiplication of shell-bearing mollusks, while in New England, granitic formations prevail, and the soil from such rocks retards the increase of these animals.—*To be continued.*

THE PHOSPHORESCENCE OF THE SEA.

THE *Noctilucæ* are little crystal balls of about the size of a pin's head, which, under the microscope, present the appearance here figured. The transparence of its structure permits an easy investigation. Not a fibre is to be seen, unless, with De Blainville, we consider the transverse markings of the tail in the light of muscular fibres, a supposition which is very questionable. In the neighborhood of this tail there is usually a mass of food, or the indigestible remains of food. Not that we are to look for a stomach in this animal,—nothing of the kind exists; but in lieu thereof we find, as in Infusoria, a number of *vacuolæ*, or assimilating cavities, which appear and disappear, according to need, formed out of the contractile substance which is seen radiating in filaments all through the substance of the animal, and which M. Quatrefages likens to the *sarcode* described by Dujardin. In this curious animal, not a trace has been discovered of vessels, nerves, senses, or indeed of any "organs" whatever. It is a mass of animated jelly, with a mobile tail. Its mode of reproduction has been variously expounded, but the observations of Quatrefages and Krohn seem placed beyond a doubt by those recorded in Mr. Brightwell's paper, proving that they multiply by spontaneous subdivision. No one has yet observed anything like reproduction by means of ova.

Noctiluca. From CARPENTER.

To these *Noctilucæ* the sea owes much of that brilliant phosphorescence which at all times has been the marvel of

travellers. Place your vase in a darkened room, and strike the glass, or agitate the water, and you will be delighted with the spectacle presented. From every part brilliant sparks appear and disappear, until at length no agitation of the water will produce more; their power is exhausted, as that of the electric eel is exhausted, after a few shocks. You want to know the cause of this phosphorescence? Unhappily the point is still *sub judice.* It is only since the beginning of this century that the attention of naturalists has been fixed upon the *Noctilucæ* as sources of the phosphorescence, in all times observed, and in former times attributed to the presence of decaying organic substance, to electricity, to "an absorption of solar light disengaged in the dark." The investigations of M. Quatrefages led him to the following conclusions:

There are two different kinds of phosphorescence observed in the sea. The first is of very brilliant but isolated sparks, and is due principally to Starfishes, Crustaceans, and Annelids. The second is of a general luminous tint, over which are strewed isolated sparks, and is due to the Noctilucæ. These Noctilucæ have no special organ which produces the phosphorescence, as the other animals have; but the light emanates from the whole substance of their bodies. Every irritant, no matter of what nature, produces this phosphorescence in them. The phenomenon is not, as in insects, one of combustion; but is intimately connected with the contraction, spontaneous or provoked, of their substance. It is independent of all secretion, and it is probable that the sparks are due to the rupture and sudden contraction of their sarcodic filaments; while the steady light they emit in dying, results from the permanent contraction of this sarcodic substance.—*From Lewes' Sea-side Studies.*

REVIEWS.

Ornithology and Oölogy of New England. By *Edward A. Samuels.* Boston. Nichols & Noyes. 1867. 8vo. Illustrated.

We welcome this work as one long needed, and trust that it will prove the forerunner of a large series of similar ones in the various departments of Natural History. The demand for books on this and kindred subjects is now quite large, and fast increasing, and we only regret that the price of the present volume may put it above the reach of the large number of persons who would advantageously peruse its pages, if within their means. May we not hope that the enterprising publishers of the work, who deserve great praise for their present undertaking, will issue a cheaper edition, that it may become accessible to all?

The volume is gotten up in fine style, and no expense has been spared on the typography and paper. The four plates containing the illustrations of the eggs* are perfect gems of the art of wood-cutting in this country, and show to what perfection it can be carried. It is greatly to be regretted that the fifty or sixty illustrations of birds were not executed for the work with the same care, for they only serve to mar the beauty of the book, and are, with few exceptions, of very little value to the reader.

The character of the work is such as to instruct and interest; the scientific details and matters of classification are well arranged, and copied from the best authors, for which full credit is given. In fact, the author has, so far as we can judge, been honest with all his quotations and clippings from others, and in writing such a work originality in all its details would be almost an impossibility, and in the present state of ornithology wholly uncalled for. That part relating to the habits and nesting of our birds contains much of original observation and research. The practical bearing of many of the observations of the author renders them of great value to the farmer and fruit-grower, and will serve to remove many prejudices that have arisen regarding the comparative benefit and injury derived from the feathered inhabitants of our gardens and woods. Thus, while the

* These four plates contain representations of the eggs of the following birds: — Pigeon Hawk, Sparrow Hawk, Red-shouldered Hawk, Broad-winged Hawk, Great-crested Flycatcher, Blue Yellow-backed Warbler, Water Thrush, Black-throated Green Warbler, White-bellied Nuthatch, Red-bellied Nuthatch, White-throated Sparrow, Snow-bird, Tree Sparrow, Rose-breasted Grosbeak, Orchard Oriole, Rusty Blackbird, Canada Grouse, Killdeer Plover, Semipalmated Plover, American Woodcock, Wilson's Snipe, Upland Plover, Virginia Rail, Carolina Rail, Herring Gull, Laughing Gull, Kittiwake Gull, Wilson's Tern, Least Tern.

author's account of the habits of the "Poor Crow" may be the cause of many being destroyed at certain seasons of the year, his account of the food of the Robin will undoubtedly be the saving of the lives of thousands of these, by some, most loved, and by others, most persecuted of birds. We extract the following from the account of the habits of the Robin:—

Perhaps none of our birds are more unpopular with horticulturists than this; and I will here give the observations of different scientific men, and my own, to show that the prejudice against the bird is unjust and unfounded. Mr. Trouvelot, of Medford, Mass., who is engaged in rearing silkworms, for the production of silk, is troubled by the Robin to a degree surpassing most other birds. He has a tract of about seven or eight acres enclosed, and mostly covered with netting. He is obliged, in self-defence, to kill the birds which penetrate into the enclosure and destroy the worms. Through the season, probably ten robins, for one of all others, thus molest him; and, of scores of these birds which he has opened and examined, none had any fruit or berries in their stomachs,—nothing but insects. It is to be understood that this was not in a part of the summer when berries were unripe; on the contrary, it was all through the season. His land is surrounded with scrub-oaks and huckleberry-bushes. These latter were loaded with fruit, which was easier of access to the birds than the worms; but none was found in them. He says they came from all quarters to destroy his silkworms, and gave him more trouble than all the other birds together. He said that, in his opinion, if the birds were all killed off, vegetation would be entirely destroyed. To test the destructiveness of these marauders, as he regarded them, he placed on a small scrub-oak near his door two thousand of his silkworms. (These, let me say, resemble, when small, the young caterpillar of the apple-tree moth.) In a very few days they were all eaten by Cat-birds and Robins,—birds closely allied, and of the same habits. This was in the berry season, when an abundance of this kind of food was easily accessible; but they preferred his worms. Why? Because the young of these, as well as those of most other birds, *must* be fed on animal food. Earthworms assist in the regimen; but how often can birds like the Robin, Cat-bird, Thrush, etc., get these? Any farmer knows, that, when the surface of the ground is dry, they go to the subsoil, out of the reach of birds; and it is not necessary here to say what proportion of the time the ground is very dry through the summer. Caterpillars, grubs of various kinds, and insects, therefore constitute the chief food of these birds; and of these, caterpillars and grubs being the most abundant, and most easily caught, furnish, of course, the larger proportion.

In fact, the Thrushes seem designed by nature to rid the surface of the soil of noxious insects not often pursued by most other birds. The warblers capture the insects that prey on the foliage of the trees; the flycatchers seize these insects as they fly from the trees: the swallows capture those which have escaped all these; the woodpeckers destroy them when in the larva state in the wood; the wrens, nuthatches, titmice, and creepers eat the eggs and young that live on and beneath the bark; but the thrushes subsist on those that destroy the vegetation on the surface of the earth. They destroy nearly all kinds of grubs, caterpillars, and worms that live upon the greensward and cultivated soil, and large quantities of crickets and grasshoppers before they have become perfect insects. The grubs of locusts, of harvest-flies, and of beetles, which are turned up by the plough or the hoe, and their pupæ when emerging from the soil; apple-worms, when they leave the fruit and crawl about in quest of new shelter; and those subterranean caterpillars, the cutworms, that come out of the earth to take their food,—all these, and many others, are eagerly devoured by the Robin and other Thrushes. The cutworms emerge from the soil during the night to seek for food; and the Robin, which is one of the earliest birds to go abroad in the morning, is very diligent at the dawn of day in hunting for these vermin before they have gone back into their retreat. The number of these destructive grubs is immense. "Whole cornfields," says Dr. Harris, "are sometimes laid waste by them. Cabbage-plants, till they are grown to a considerable size, are very apt to be cut off and

destroyed by them. Potato-vines, beans, beets, and various other culinary plants, suffer in the same way." The services of the robins, in destroying these alone, would more than pay for all the fruit they devour. Indeed, during the breeding season, a robin is seldom seen without having in his mouth one of these caterpillars, or some similar grub, which he designs for his young; and as the Robin often raises three broods of young during the season, his species must destroy more of this class of noxious insects than almost all other birds together. In my own gardening experiences, I have had my full share of cutworms; and I have always noticed the Robin, Brown Thrush, and Cat-bird busy early in the morning,—almost before other birds are out of their feather-beds, figuratively speaking,—catching these vermin and eating them, or carrying them for food to their young.

THE CRETACEOUS FORMATION OF THE ENVIRONS OF SIOUX CITY, OF THE MISSION OF OMAHAS AND OF TEKAMA, ON THE BORDERS OF MISSOURI. By *Jules Marcou.* From the Bulletin of the Geological Society of France. 1866. 8vo, pp. 15. With a plate.

In this and a previous paper,* the author shows that there is a remarkable discrepancy between the usually accepted laws of the geological succession of animals and plants, and the natural sequence of the rocks containing them. The facts are thus stated in the present article:—

Between Omaha City, Nebraska, and Sioux City, is a fresh-water formation containing a flora entirely composed of genera, which, in Europe, have appeared only at the epoch of the Miocene (middle) Tertiary Period, but which in America, however, is found in the middle of the Cretaceous Period, at the base of the chalk formation.

The steps that led to this discovery are detailed quite fully by Prof. F. V. Hayden, in the American Journal of Science for March, 1867.

LEPIDOPTEROLOGICAL NOTES AND DESCRIPTIONS, I, II. *By Aug. R. Grote* and *Coleman T. Robinson.* 8vo, pp. 30. 1865-6. With five plates.

NOTES ON THE SPHINGIDÆ OF CUBA. *By Aug. R. Grote.* 8vo. 1865. With two plates.

NOTES ON THE ZYGÆNIDÆ OF CUBA. *By Aug. R. Grote.* 8vo, pp. 16.

NOTES ON THE LEPIDOPTERA OF AMERICA. By *A. R. Grote* and *Coleman T. Robinson.* New York, 1867. 8vo, pp. 35. With two plates.

In a series of papers, of which we select the titles of but a few, published by these authors in the Proceedings of the Entomological Society of Philadelphia, and the Annals of the Lyceum of Natural History of New York, are descriptions of new and interesting forms of our native moths, accompanied by admirably executed lithographic plates, wherein are figured many of the rarer species, either new or previously described.

The authors have delineated many of the forms of that beautiful and

*A Geological Reconnoisance in Nebraska. From the Bulletin of the Geological Society of France, 1864.

interesting group of moths, the Bombycidæ, which contain the silk-worms of the old and the new world.

If, while reading the account of the American Silk-worm given in this journal, the reader wishes to become acquainted with its numerous allies, he cannot do better than consult the well-executed plates accompanying the papers under review. In several articles, such as those on the Sphinges and Zygænidæ, or Day-flying moths, of the Island of Cuba, prepared by the first-named author, and also accompanied by lithographic plates, many facts are adduced to show how close is the connection between the tropical insect fauna of Cuba, and the more temperate fauna of the United States. Without bringing out such interesting results as these, isolated descriptions of species are certainly dry reading and of little immediate profit to science.

THE TAXIDERMIST'S MANUAL. Third Edition. By *S. H. Sylvester.* Middleboro', Mass. 16mo, pp. 29. Price $1.00.

A very brief, but so far as it goes, accurate account of the mode of stuffing birds and mammals, with a few words on the methods of preparing skeletons, preserving eggs, and mounting insects. The information given is too scanty, and wood-cuts should have been added illustrating the methods described. The price of this little book is altogether too high.

THE AMERICAN AGRICULTURIST. Orange Judd & Co., New York.

We cannot speak in too high praise of the Natural History illustrations in the above-named journal. Every number issued contains numerous illustrations of animals and plants, drawn with fidelity, and engraved with the utmost skill. The generous manner in which this branch of science is treated, renders the journal alike valuable to the lover of nature, and to the agriculturist.

AMERICAN POMOLOGY. APPLES. By *Dr. John A. Warder.* 29 Illustrations. New York, Orange Judd & Co., 41 Park Row. 12mo, 1867.

A carefully prepared and well-printed volume, which must prove of great value to all fruit-growers. While the book is intended for readers in all parts of the country, it is especially adapted to the wants of pomologists in the Western States.

A very useful and rather new feature in this compact manual is the large number of pages (fifty-five) devoted to the insects injurious to the apple, of which over eighty species are noticed, with short descriptions, notes regarding their habits, and remedies against their attacks, which contain many practical suggestions.

The chapters on the History of the Apple, Propagation, Dwarfing, and Diseases, must interest all scientific horticulturists.

NATURAL HISTORY MISCELLANY.

BOTANY.

TENACITY OF LIFE AMONGST THE HIGHER PLANTS. — Specimens of *Lewisia rediviva*, a Portulacaceous plant, large-flowered and fleshy, growing in British Columbia, Oregon, and California, will grow, although they have been dried and in the herbarium for two or three years; and indeed the samples are often troublesome from sprouting whilst between the papers. One species, collected by Dr. Lyall, of the British Navy, was "immersed in boiling water" to stop this growing propensity, before submitting to the drying process, and yet more than a year and a half afterwards it showed symptoms of vitality, and in May, 1863, it produced its beautiful flowers in the Royal Gardens at Kew. — *Quarterly Journal of Science.*

REMAINS OF PLANTS AND ANIMALS IN A BRICK TAKEN FROM THE PYRAMIDS OF EGYPT. — Professor Unger has communicated to the Imperial Academy of Sciences, at Vienna, a paper on the vegetable and animal remains and relics of manufacturing art, contained in a brick taken from one of the Egyptian pyramids. He examined a brick from the pyramids of Dashour, which dates back from between 3,400 and 3,300, B. C., and found imbedded in the Nile mud or slime of which it is composed, animal and vegetable remains so perfectly preserved that he had no difficulty whatever in identifying them. Besides two sorts of grain he found the following familiar plants, *Pisum arvense, Linum usitatissimum, Raphanus raphanistrum, Chrysanthemum segetum, Euphorbia helioscopia, Chenopodium murale, Bupleurum aristatum*, and *Vicia sativa*. The brick contained chopped straw, thus confirming the account of the brick-making given in Exodus. The manufacturing relics consisted of fragments of burnt tile, pottery, and a small piece of twine spun from flax and sheep's wool, significant of the advance which civilization had made more than 5,000 years ago. Prof. Unger thinks that by a careful examination of a large number of bricks, much light may be thrown on the civilization of ancient Egypt. The bricks also contained abundant remains of fresh-water shells, insects, fishes, etc. — *Quarterly Journal of Science, London.*

ZOÖLOGY.

FISH CULTURE. — In the International Exposition of the Produce and Implements of Fisheries, at Bergen, were collections of young

fish, illustrating the development of the Cod, presented by M. O. Sars; of the Herring, by M. A. Boeck; and of the Trout, by C. Vogt. A series of designs were also exhibited representing the history of their development, from the vesicular state (l' état vésiculaire) in the egg, up to the moment of exclusion, and the different aspects of the fish from the time of birth to adult age. Next the drawings were placed jars containing specimens illustrating the different stages of growth. Several bottles,containing specimens illustrating the process of the artificial fecundation of the Cod, discovered by M. O. Sars, comprised:

1. Eggs of the Cod artificially fecundated, three or four hours after the operation, and showing the beginning of the divisions of the germinative disk (*disque*); 2. Eggs artificially fecundated, eleven or twelve hours after the operation, and showing the division of the germinative disk; 3. Eggs artificially fecundated, after two or three days, showing a greater division of the disk; 4. Eggs after four days of incubation, showing the perfect division of the disk; 5. Eggs eight days after artificial fecundation, showing the embryo already well formed; 6. Eggs sixteen days after artificial fecundation, showing the young fish (*alevin*) perfectly developed, and after the rupture of its envelopes; 7. Young Cod born the seventeenth day after artificial fecundation.—*Bulletin de la Societe d' Acclimatation.*

Biscuit made of Fish.—Professor Rosing, of Aas, France, has invented a biscuit of flour made of fish (*farine de poisson*), prepared like the sea biscuit. It forms a very nutritious and compact article of food, being four times as rich in albuminoid substances as beef, four and a half times as much as fresh codfish, and sixteen times as much as fresh milk. Besides, it has the advantage of being very rich in phosphates.—*Bulletin de la Société impériale Zoologique d' Acclimatation.*

The Pelican in Cayuga County, N. Y.—Some time during the spring of 1864, near a marsh on Cayuga Lake, two large birds were seen for several weeks, but one of them left a few days before the other was killed. None of the hunters had ever seen anything of the kind about here before. It proved to be a specimen of the white or rough-billed Pelican (*Pelicanus erythrorhynchus* Gmelin), in good condition, and its wings measured fully eight feet from tip to tip.

Prof. S. F. Baird, of the Smithsonian Institute, Washington, D. C., in speaking of this bird says:—

The male has on the upper mandible [upper part of the bill] a thin, elevated, bony process, about one inch high, and extended towards the end for three or four inches. The female differs in not having the bony projection on the upper mandible. It lives throughout the United States; rare on the coast of the Middle and Northern States; found as far north as the 61st parallel. This species breeds in the far countries, generally selecting inaccessible places in the neighborhood of waterfalls. They also inhabit throughout the Rocky Mountains and in California. In winter they are very abundant on our Southern coast, from Texas to Florida. They remain inactive on sand-bars most of the day, procuring their food about sunrise, and again just before sunset. They swim buoyantly, and while feeding are very active in their movements; on such occasions they do not dive, but

secure their food by thrusting the head under water, but not keeping it below the surface for any length of time. The peculiar bony process on the ridge of the upper mandible appears to be used for the purpose of defence, when combating with their rivals; in some old individuals it is much abraded and worn, apparently caused by many and severe contests.

Audubon thus speaks of its habits:—

Ranged along the margins of the sand-bar, in broken array, stand a hundred heavy-bodied Pelicans, pluming themselves. The gorged Pelicans patiently wait the return of hunger. Should one chance to gape, all, as if by sympathy, in succession open long and broad mandibles, yawning lazily and ludicrously.

I one afternoon observed a number of White Pelicans swimming against the wind and current, with their wings partially extended, their neck stretched out, the upper mandible alone appearing above the surface, while the lower must have been used as a scoop-net, as I saw it raised from time to time, and brought to meet the upper, when the whole bill immediately fell to a perpendicular position, the water was allowed to run out, and the bill being again raised upwards, the fish was swallowed. After thus swimming for about a hundred yards in an extended line, and parallel to each other, they would rise on the wing, wheel about, and re-alight at the place where their fishing commenced, when they would repeat the same actions. The number of small fishes destroyed by a single bird is quite extraordinary. On opening one we found in its stomach several hundreds of fishes, of the size of what are usually called minnows. Its flesh is rank, fishy, and nauseous. The female is rather smaller than the male, and, in as far as I am warranted by the examination of several individuals in stating, is destitute of the horny crest of the upper mandible.

Judging from the bony process on the bill, which was about one inch high and two and a half inches long, I concluded, from the description given above, that this bird was a male; but upon dissection, I was much surprised to find the specimen a female.

The œsophagus contained two flat-fish (Bream or Pumpkin-seed, *Pomotis vulgaris*) in quite a perfect condition, one of which was six and the other eight inches in length. There were also the remains of two bull-heads, which must have been eight or ten inches in length. I found no small fish. Mr. Cave, who shot the bird, saw her fishing, as described by Audubon.—W. J. Beal.

Curious Mode of Gestation in Fish.—Dr. W. Turner, of Edinburgh, described the very curious method of gestation in a new fish, belonging to the genus *Arius*, which he had received from Ceylon. The female fish deposits her eggs, which are then taken into the mouth of the male, who swims about with them until they hatch. Dr. Turner's correspondent had been very careful to avoid any mistake or imposition in the matter. The fish lived in stagnant pools in marshy ground, where they were caught in large numbers by the natives. Dr. Günther, of the British Museum, said it was very remarkable that in South America there was a fish almost exactly like that which Dr. Turner had described; and Agassiz had lately described several others from the Amazon, possessing this curious method of gestation; none, however, had been observed in Africa.—*Quarterly Journal of Science, London.*

Habits of the Bittern.—I notice some statements respecting the breeding habits of the Bittern (*Botaurus lentiginosus*) in the lately published work of Mr. Samuels, on the Ornithology and Oölogy of New England, which are entirely at variance with my experience. He says that these birds build in bushes or low trees or tufts of grass; that the nest is of twigs, grass, and a few leaves; and that they breed in communities, a dozen or more nests being often found in the space of a few rods.

The few eggs that I have found have all been on the ground—the bare ground—among thick tufts of lambkill, on the "Fowl Meadows," which skirt the upper part of the river Neponset; nor have I been able to find more than one nest on ten acres, though I have searched most carefully. I make these remarks because I think no part of the bird's history ought to go unnoticed; and because I am convinced that he, who should expect to find a community of stick-built bittern's nests on bushes or trees in this vicinity, would be disappointed.

South Canton, Mass. W. E. Endicott.

GEOLOGY.

The Miocene Tertiary Flora of North Greenland.—Different voyagers have, from time to time, brought from Greenland, and lodged in various museums in Britain and Ireland, rich collections of fossil plants, all of which have been submitted to Professor O. Heer, a Swiss Naturalist. They were all found 1,080 feet above the sea, on a steep hill, at Atanckerdluk, opposite the Isle of Disco, in lat. 70° N. A total of sixty-six species have been recognized, and from them and their associated facts, the author infers that they must have grown where they were found; that they belong to a Miocene flora rich in species, at least some of which extended to still higher latitudes; that in the Miocene epoch the climate of North Greenland was warmer than it is at present by fully 16° C., or 28′ 8° F.; and he thinks that "we could not by any rearrangement of land and water produce for the northern hemisphere a climate which would explain the phenomena in a satisfactory manner." "We must admit," he adds, "that we are face to face with a problem whose solution in all probability must be attempted, and we doubt not completed by the astronomer."—*Quarterly Journal of Science, London.*

MICROSCOPY.

Phosphorescent Entomostraca.—Minute Crustaceans, belonging to this order and allied to the genus Cypridina, were discovered in

the Pacific Ocean by Prof. J. D. Dana, while in the United States Exploring Expedition. Others have been described and figured by Major Owen, in the Microscopical Journal for 1866:—

When these were taken, the sea was alive with them. When swallowed by, or entangled with other creatures, they in their turn appear to be also luminous. They also give luminosity to the water itself as it flows over them. When they are at rest, they gradually cease to give out light; but as soon as they are disturbed or in motion, or the vessel containing them is shaken, they again become bright, even after many hours' confinement. . . . I have seen the ship's deck running with liquid fire when the net containing this species had been taken on board.

CORRESPONDENCE.

L. Q., Pennsylvania, asks for information regarding the preparation of snail's tongues for microscopical objects. They are generally mounted in Canada balsam, using a thin piece of glass as a cover to the preparation.

To dissect the membrane from the mouth, one must use needles for the very small snails, and fine knives for the larger species. One can cut with certainty on such snails as *Helix albolabris*, by slitting the œsophagus open from above, care being taken not to cut the jaw, which can be plainly seen with the naked eye. The incision is made between the larger tentacles. The membrane bearing the minute teeth is quite tough, and can be picked away with needles. For the minute snails the readiest way is to pick the head in small pieces on a glass slide. With the microscope, the portion containing the tongue can be readily detected by the tessellated appearance of that organ. All other fragments are then wiped from the slide, and the membrane can be then separated by gently pulling apart the fragment into numerous pieces, and again examining with the glass, removing as before all the bits of muscular fibre not connected with the tongue. With considerable care and patience the tongue may be removed entire. During this work the preparation must be well moistened; a drop of water is sufficient.—E. S. M.

E. L., Illinois.—The following works have been published on North American Lichens:—"A Synopsis of the Lichens of New England, the other North American States, and British America." By Edward Tuckerman, A. M., Cambridge, 1848. 1 vol. 8vo, 93 pp. "An Enumeration of North American Lichens, with a Preliminary View of the Structure and General History of these Plants, and of the Friesian System," etc. By Edward Tuckerman, A. M. Cambridge, 1845. 8vo, pp. 59.

W. H. S., Minnesota.—You will find Shirley Hibbard's Book of the Aquarium, published in London, 1856, the cheapest and best manual

we know of. For fresh-water aquaria, use glass jars and dishes. Large aquaria can be made of glass set in a soapstone frame, made water-tight by cement. Any glazier can make one. Shirley Hibbard thus describes a large tank:—

"For the adornment of a dwelling-room, or a conservatory, an oblong tank, measuring three feet by one foot six inches deep, would be very suitable. It must be borne in mind, then, that when a tank is filled, its weight is enormous, and hence it is difficult, sometimes impossible, to move it without first removing the whole or greater portion of its contents. Strength in the joints to resist pressure from within, and strength in the table or other support on which the tank is placed, is of the first importance. The bottom of such a tank is best formed of a slab of slate, and the two ends may be of slate also; the front and back of plate or very stout crown glass. The most elegant form for such a body is that of the double cube, the length of the tank being just double its width and depth, so that if it were cut into two equal parts, two cubes would be formed. The glass must be set in grooves in the slate, and bound outside with zinc or turned pillars of birch wood. The best cement is white-lead putty, or what is known as Scott's Cement, the composition of which it is not in my power to inform the reader. If a coating of shell-lac, dissolved in naphtha, and made into a paste with whiting, were laid over the white lead cement, the water would be kept from contact with the lead, and the tank would require less seasoning.

The use of slate at the ends is to enable us to affix rock-work, or carry across a rude arch; the cement used in constructing rock-work does not adhere to glass. But if rock-work is not thought desirable, the slate ends may be dispensed with, and the vessel may be composed wholly of glass, except the bottom, which may be of slate or wood. I have seen some handsome tanks composed wholly of wood and glass; it is only necessary to choose well-seasoned material, and unite the joints very perfectly.

L. Q., Pennsylvania.—We can scarcely tell from your drawing what the object can be. It is probably a Polyzoön, and possibly a species of *Lophopus*, mentioned in the June number of the NATURALIST, and if so, is very rare, and specimens would be very desirable.

NATURAL HISTORY CALENDAR.

THE INSECTS OF AUGUST.—During this month great multitudes of bugs (*Hemiptera*) are found in our fields and gardens; and to this group of insects the present chapter shall be devoted. They are nearly all injurious to crops, as they live on the sap of plants, stinging them with their long suckers. Their continued attacks cause the leaves to wither and blight.

The grain Aphis, at certain years, desolates our wheat-fields. We have seen the heads black with these terrible pests. They pierce the grain, extract the sap, causing it to shrink and lose the greater part of its bulk. It is a most insidious and difficult foe to overcome.

The various leaf-hoppers, *Tettigonia* and *Ceresa*, abound on the leaves of plants, sadly blighting them; and the *Tettigonias* frequent

damp, wet, swampy places. A very abundant species on grass produces what is called "frog's spittle." It can easily be traced through all its changes by frequently examining the mass of froth which surrounds it. *Tettigonia vitis* blights the leaf of the grape-vine. It is a tenth of an inch long, and is straw-yellow, striped with red. *Tettigonia rosæ*, a still smaller species, infests the rose, often to an alarming extent.

Fig. 1.

The *Notonecta*, or water boatman, is much like a *Tettigonia*, but its wings are transparent on the outer half, and its legs are fringed with long hairs, being formed for swimming. They row over the surface in pursuit of insects. *Notonecta undulata* of Say (Fig. 1, from Sanborn) is a common form in New England.

Another insect-hunter is the singular *Ranatra fusca* (Fig. 2, from Sanborn). It is light brown in color, with a long respiratory tube which it raises above the surface of the water when it wishes to breathe. This species connects the Water-boatman with the Water-skaters, or Gerris, a familiar insect, of which *Gerris paludum* (Fig. 3) is commonly seen running over the surface of streams and pools.

Fig. 2.

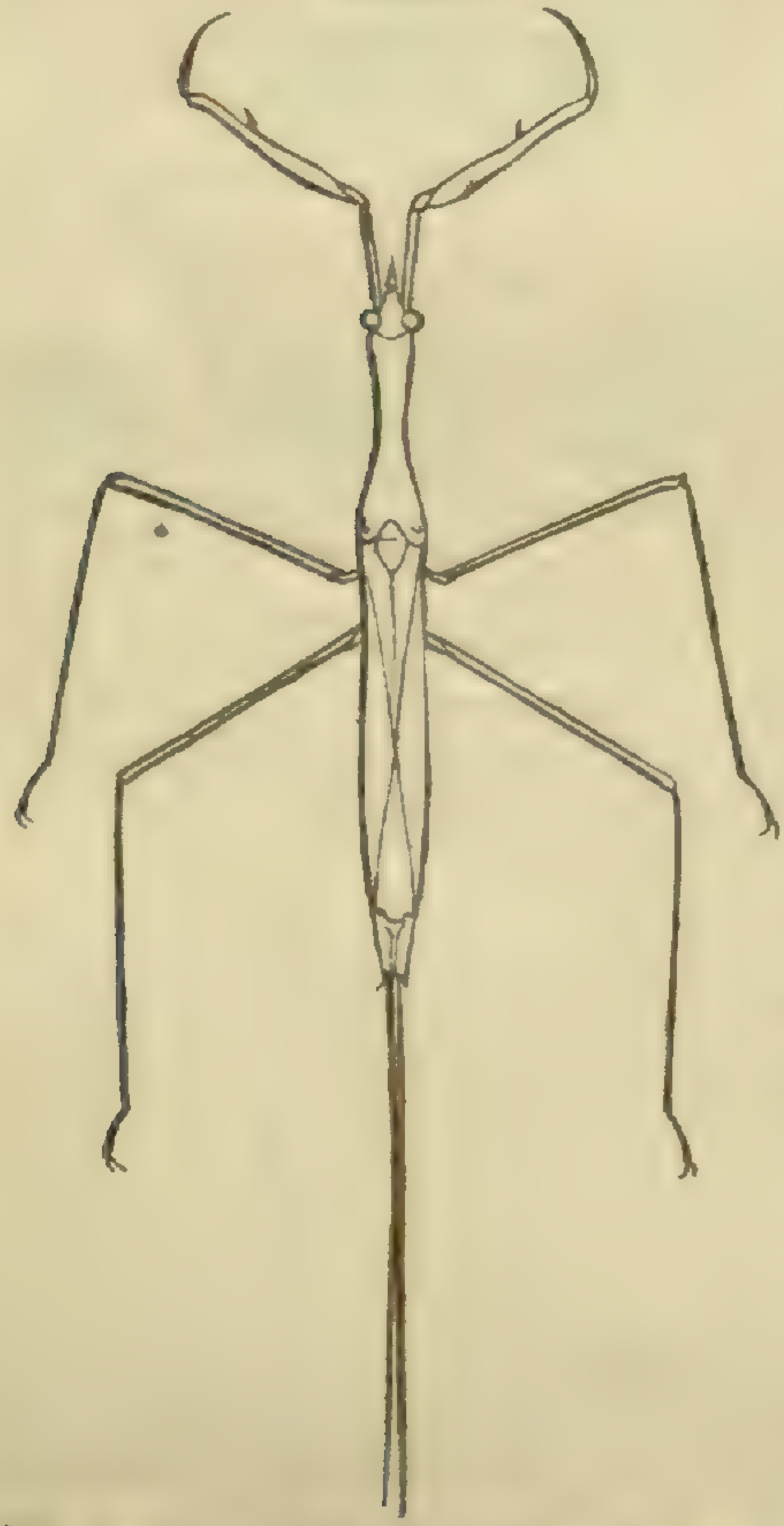


Fig. 3.

Fig. 4.

Reduvius and its allies belong to a large family of very useful insects, as they prey largely on caterpillars and noxious insects. Such is *Pirates picipes* (Fig. 4), a common species. It is an ally of *Reduvius personatus*, a

valued friend to man, as in Europe it destroys the bed-bug. Its specific name is derived from its habit while immature, of concealing itself in a case of dust, the better to approach its prey.

Another friend of the agriculturist is the *Phymata erosa* (Fig. 5). Mr. F. G. Sanborn states that "these insects have been taken in great numbers upon the linden trees in the city of Boston, and were seen in the act of devouring the Aphides, which have infested the shade-trees of that city for several years past. They are described by a gentleman who watched their operations with great interest, as 'stealing up to a louse, coolly seizing and tucking it under the arm, then inserting the beak and sucking it dry.' They are supposed to feed also on other vegetable eating insects as well as the plant louse."

Fig. 5.

Phytocoris lineolaris swarms in our gardens during this month. It is described and figured in Harris's Treatise on Insects. Closely allied, though generally wingless, is that enemy of our peace the bed-bug. It has a small, somewhat triangular head, orbicular thorax, and large, round, flattened abdomen. It is generally wingless, having only two small wing-pads instead. The eggs are oval, white; the young escape by pushing off a lid at one end of the shell. They are white, transparent, differing from the perfect insect, in having a broad, triangular head, and short thick antennæ. Indeed, this is the general form of lice (*Pediculus vestimenti*, and *P. capitis*), to which the larva of Cimex has the closest affinity. Some Cimices are parasites, infesting pigeons, swallows, etc., in this way also showing their near location to lice. Besides the *Reduvius*, the cockroach is the natural enemy of the bed-bug, and destroys large numbers. Houses have been cleared of them after being thoroughly fumigated with brimstone.

Closely allied to the bed-bug are the lice (*Pediculus*). These degraded, wingless forms of Hemiptera, still preserve the mouth parts in the form of a sucker, but it is fleshy and retractile. The triangular head has two simple eyes. The body is rather long, the abdomen oval. They are generally white, and of minute size. The metamorphosis is very incomplete, — that is, there are but slight differences between the larva and the imago. The species of *Pediculus* are blood-suckers, and parasitic upon man and some of the mammalia; different species being found upon different regions of the body. Different varieties are found living upon the bodies of different races of men.

An allied group, the *Mallophaga*, bird-lice, live on the hair of mammalia and feathers of birds. In this group there are distinct jaws. Nearly every bird and mammal has its parasite, so that the number of species is actually very large.

During this month the ravages of grasshoppers are, in the West, very wide-spread. We have just received from Major F. Hawn, of Leavenworth, Kansas, a most interesting account of the Red-legged Locust (*Caloptenus femur-rubrum*). "They commence depositing their eggs the latter part of August, which are fusiform, slightly gibbous, and of a buff-color. They are placed about three-fourths of an inch beneath the surface, in a compact mass around a vertical axis pointing obliquely up and outward, and are partially cemented together, the whole presenting a cylindrical structure, not unlike a small cartridge. They commence hatching in March, but it requires a range of temperature above 60° F. to bring them to maturity, and under such conditions they become fledged in thirty-three days, and in from three to five days after, they enter upon their migratory flight.

"Their instincts are very strong. When food becomes scarce at one point, a portion of them migrate to new localities, and this movement takes place simultaneously over large areas. In their progress they stop at no obstacle they can surmount. In these excursions they often meet with other trains from an opposite direction, when both join in one.

"The insects are voracious, but discriminating in their choice of food, yet I know of no plant they reject if pressed by hunger; not even the foliage of shrubs and trees, including pine and cedar."—A. S. P.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

LYCEUM OF NATURAL HISTORY. *New York, April* 22, 1867.—Prof. Newberry read a paper on the "Ancient Vegetation of North America." In this paper the Professor briefly reviewed the records with which geology has furnished us of the changes that have taken place in the vegetation of this continent, from the earliest palæozoic ages to the present time. Of this sketch the most important facts cited were as follows:—

First,—Vegetables only have the power to assimilate inorganic substances in nature, the animal kingdom being wholly dependent on the vegetable for its substance, and could not exist without it. Plants must therefore have preceded animals upon the globe, and spontaneous generation, if it were possible, should result in the production of plants first, of animals only from them. Remains of plants occur in the oldest rocks, but only of the lowest types, seaweeds.

Second,—The first land plants appear in the Upper Devonian rocks,

conifers, ferns, lycopods, etc., the advance guard of the carboniferous flora, and having the same general character. From the variety and comparatively high organization of these plants we must infer either the somewhat sudden creation of an elaborate flora, or a great hiatus in geological history, in which its origin and development are lost.

Third, — The carboniferous flora of America is essentially the same as that of the coal-measures of the old world. Of six hundred species recognized here, at least one-third are considered identical with European forms, while the genera are nearly all the same.

The carboniferous period was one of depression in this country; the western part of the continent being all beneath the ocean, though extensive land-surfaces had existed there before. A belt of country north of the St. Lawrence was then — as it has constantly been since the beginning of the palæozoic ages — out of water, as was most of New York, and part of New England. The coal-plants grew in marshes on the western margin of the land at the sea level; a gradual submergence producing a succession of vegetable deposits, one above another. The climate was moist, uniform, and warm, but not hot, as vegetable matter would, in that case, have decayed and not bitumenized. The atmosphere was also more highly carbonated than now.

Dr. Newberry exhibited drawings of some of the most characteristic plants and fruits of the coal period, with many not yet described. He said, also, that from the similarity of the flora of the coal-measures in different countries we must conclude that all the vegetation of the world at this period was of the character indicated by these specimens, and that more highly-organized plants had not yet been called into existence.

Fifth, — The Permian flora was not represented in any collection made on this continent, but from the plants obtained from the Permian rocks abroad, it was evident that the flora of that period was, like the fauna, but a continuation of that of the carboniferous.

Sixth, — In passing the interval which separates the mesozoic from the palæozoic ages we entered a new world, in which all the aspects of nature were quite unlike those of the preceding periods. New mollusks and new fishes swim in the seas; reptiles were the monarchs of animated nature, — swimming, walking, flying, carnivorous and herbivorous, in size ranging from the mouse to the whale, they filled the places now occupied by reptiles, birds, and mammals. The vegetation of the triassic and jurassic periods was as peculiar as the fauna, and constituted a distinct chapter in the botanical history of the world. The most conspicuous plants of this flora were the cycads, — now represented, by the *Lagopalene*, etc., — which had no existence before,

and has since formed an insignificant portion of the vegetation of the earth's surface. Drawings were exhibited of cycads, conifers, and ferns from the mesozoic rocks of Europe, China, North Carolina, New Mexico, and Sonora, showing the similarity of the flora of different countries in the triassic and jurassic periods.

Seventh, — With the commencement of the cretaceous period the flora of the world was again revolutionized, and the highest order of plants — the angiosperms — make their first appearance; in Europe, mingled with the remains of the preceding flora, in America in overwhelming numbers. In the lower cretaceous rocks of this continent we have already discovered nearly one hundred species of broad-leaved dicotyledonous plants, including several genera now living in our forests, such as willows, poplars, tulip-tree, sassafras, magnolia, sycamore, beech, etc. From these facts it appears that the vegetation of North America had not greatly changed from the beginning of the chalk period to the present time, showing great permanence in the physical condition of the country.

Eighth, — Of our Eocene flora we have obtained few specimens. The flora of Europe, during that period, was decidedly tropical in character.

Ninth, — The Miocene flora of America has been very fully illustrated by the collections made in Mississippi, on the Upper Missouri, near the mouth of Frazer River, on the McKenzie, and on Disco Island, off the west coast of Greenland. Over one hundred species have been obtained from these localities, some of which were common to them all. Several of these species are now living in our country, and quite a number have been found in the Miocene tertiary of Europe.

The most important part of Dr. Newberry's paper was that which included a comparison of the Miocene flora of America with that of Europe of the same age, and both with living floras of the two continents. The conclusions derived from their comparisons are briefly as follows: —

First, — The living flora of North America is the legitimate progeny of the cretaceous and tertiary floras of the same continent; most of the genera of the earlier floras being continued into the present one, and many species of the Miocene being apparently identical with some now living.

Second, — In the Miocene epoch, the European and American continents were connected at the north, and over this bridge the American flora passed to Europe, leaving its records on Disco Island, Iceland, the Island of Mull, etc. This flora is that of a temperate climate, and, following a depression of temperature, it replaced the Eocene tropical

flora of Europe, and for a time covered the surface of that country with American plants, magnolia, liquid amber, sassafras, liriodendron, etc., etc.

Third,—That at a subsequent period, the connection between the two continents was severed by a depression of North-west Europe, and the American flora was nearly exterminated by the present flora of Europe, which is mostly of Asiatic origin.

Fourth,—The present flora of China and Japan, as Professor Gray has shown, has many American elements, probably the living representatives of the Miocene flora. One genus, Glyptostrobus, a conspicuous feature in the Miocene flora in America and Europe, is now living only there; and several American Miocene and living species (*Onoclea sensibilis*, etc.) now form part of the flora of Japan. These plants are probably the descendants of American Miocene emigrants.

Dr. Newberry also exhibited drawings of a number of fossil fishes and reptiles from the coal-measures of Ohio. The fishes represented the genera Diplodus, Pleuracanthus, Megalichthys, Palæoniscus, Cœlacanthus, Rhizodus, Eurylepis, etc., of which the species were all new, and the last a new genus. Of the reptilian remains, the most perfect had been described by Professor Wyman, under the name of Ranaceps Lyellii; the others included several much larger and yet undescribed forms. Among these reptilian bones were two elongated vertebral columns, which, from their singular structure, in the absence of the head and extremities, had greatly puzzled our comparative anatomists. Dr. Newberry announced, however, that this mystery was solved by a recent discovery in the Irish coal-measures of complete individuals of what seemed, from the descriptions given, to be identical species. These had been described by Professor Huxley, under the name of Ophiderpton, or snake-lizard, a very appropriate name, as these reptiles had an elongated snake like form, with insignificant limbs, something similar to our living Cæcilia, but being doubtless an amphibian. The associated reptiles were also probably amphibious, aquatic in habit, and to be compared with Menopoma and Menobranchus.

The president, Professor C. A. Joy, read a report upon recent chemical discoveries and applications.

Mr. Bailey exhibited a fossil frog from the brown coal of the Rhine. It resembles closely some of the living species, and the question was discussed whether live toads were ever actually found imbedded in the rock. The president stated that there was no authentic instance of a live toad having been found in the solid rock. All such stories were myths, and no scientific man gave any credence to them.

California Academy of Natural Sciences. *San Francisco, May 6, 1867.* — The Committee on Field Excursions reported in reference to the recent excursion to the Twelve Mile Farm, on the San José Road. Mr. Lorquin mentioned the species of birds seen or collected. Mr. Yale presented a fragment of rock from the fossiliferous outcrop near the above place, — a blue sandstone, which is undergoing decomposition, containing many species of shells of post-pliocene forms, many of them the same as living species, according to Mr. Stearns. Prof. Whitney remarked upon the singularly isolated character of this outcrop, which is also quite narrow and limited. He had tried to find traces of it many miles beyond, but did not succeed. The fact was one of many evidences going to show the extensive denudation that had occurred in this part of the State. Dr. Behr presented a chrysalis of a peculiar moth from Mazatlan, the female of which does not undergo a metamorphosis or change from the grub state, while the mate is the same as other moths.

Mr. Stearns submitted, on behalf of Mr. J. Rowell, a description of a new species of *Pisidium*, a genus of fresh-water bivalves, found at Angel Island on the occasion of the late excursion, to which is given the name of *P. Angelica.* He also read a paper upon Parhelia, and a recent display of these phenomena witnessed by him in this city. Some remarks followed upon sun and moon halos, during which Dr. Gibbons combated the popular notion that halos about the moon were infallible signs of rain. His observations proved that in some seasons these signs invariably failed in California, and at the East no rule, he thought, could be established on the subject.

Mr. Goodyear read a paper by Prof. Silliman, noticing new localities of diamonds. One from French Corral weighed 5.114 grains, equal to 1¼ carats, symmetrical in form, and slightly yellow in color from being subjected to a fire test. It was found in the gravel washings. The second specimen is from Forest Hill, El Dorado [Placer?] county; weight 5.673 grains, equal to nearly 1½ carats; color good, but less perfect and symmetrical than the first. The third specimen is from Fiddletown, Amador county. It is smaller and less perfect than either of the others. Since 1855 five diamonds are known to have been found at Fiddletown, none weighing much over a carat. All were found in a gray, cemented gravel, underlying a stratum of lava or compact volcanic ashes. The fourth specimen is from Cherokee Flat, Butte county, which has acquired some reputation as a diamond locality. It has been cut and set in a ring.

Prof. Whitney remarked that there are fifteen localities in California at which diamonds have been found in the course of washings for

gold. In reply to a question if there was not some familiar test by which miners might prove them, he answered that the easiest way was to try their hardness on other gems, but miners have not always these convenient to do so. A knowledge of the crystalline form, twenty-four sided and the faces curved, was the surest test. He said that the popular notion that a diamond could be hammered on an anvil without breaking was a mistake, resulting from confounding hardness and toughness. He remark d further that it would not pay in California to wash the gravel beds solely for diamonds. Diamond washings do not pay in any country except with slave or convict labor.

Prof. Whitney read a paper on the geological position of coal. The object of this paper was to show how completely the result of modern geological explorations and discoveries had done away with the old idea that valuable beds of coal are confined to any one member of the series of geological formations. The recent investigations of geologists in India, China, Australia, New Zealand, South America, and on the Pacific Coast of North America were noticed and commented on. It was shown that while the important coal-fields of Eastern Europe and Eastern United States are of Palæozoic age, those of India, China, and Australia, on the other hand, belong to the Mesozoic series chiefly, although there are important deposits even as recent as the Cainozoic or Tertiary. Prof. Whitney remarked on the distribution of the principal coal-fields of the world into two great groups, on opposite sides of the globe; one of them is of Palæozoic and the other of Mesozoic age. He referred particularly to the coal of the Pacific coast of North America, and gave a brief account of its geographical distribution and geological age, noticing particularly the fact that most of the valuable fields of that region belong to the Cretaceous series, a geological formation which, in other parts of the world, has been found to be one of the most barren in combustible materials. In conclusion, the importance of coal discoveries in the region between the Rocky Mountains and California to the successful operation of the Pacific Railroad was explained, and the hope expressed that the geological expedition recently set on foot by the General Government—at the head of which is Mr. King, late of the California Survey—might be the means of giving to the world reliable information in regard to the coal resources of that region, of which we now know so little.

Dr. Cooper stated that Mr. Bischoff, the zoölogist appointed to accompany the Government exploration of Russian America, was now on his way hither, if he had not already arrived. When on that coast before, he had found birds nearly identical with living species in Asia, a fact of much interest, since none of the same species are found on

the eastern coast of America. There is here another suggestion of the former intimate relations between western America and Asia.

Prof. Whitney submitted for publication a very valuable and original paper by Baron Richthofer, on the subject of geology, particularly with reference to the natural system of volcanic rocks. Its publication as the first volume of the Academy's Memoirs was proposed. It consists of one hundred and fifty manuscript pages.

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The Naturalist's Note-book, No. 5. May, 1867. London, small 4to.

Notes on the Vespertilionidæ of Tropical America. By H. Allen, M.D. From the Proceedings of the Academy of Natural Sciences. August, 1866. 8vo. pp. 9.

Geographical Catalogue of the Mollusca found west of the Rocky Mountains, between latitudes 33° and 49° N. By J. G. Cooper, M. D. San Francisco, 1867. 4to, pp. 40.

Practical Entomologist. Philadelphia Entomological Society. April, May, June, 1867.

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The Taxidermist's Manual. Third Edition. By S. H. Sylvester. Middleboro', Mass. 16mo., pp. 29.

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Histoire des Picea qui se rencontrent dans les Limits du Canada. Par L'Abbé Ovide Brunet. Quebec, 1866. 8vo, pp. 16. With three plates.

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THE GEYSERS OF CALIFORNIA.

BY G. L. GOODALE, M. D.

THE Geysers of California are situated in lateral ravines of Pluton River, a tributary of Russian River.

The picturesque journey from San Francisco to the Geysers has been truthfully described by many tourists; hence most of our readers are doubtless familiar with the sail over the bay and through the Tulé marsh, the ride up the White-wine valley, the slow ascent of an outlying crest of the Coast Range, and the perilous drive down into the cañon. It is proposed to embody in this paper some observations based upon studies at the Geysers during the last week in May, 1866.

It is, therefore, necessary to pass over, without remark, the interesting journey thither, and occupy ourselves with a description of the Avernus rather than the *facilis descensus*. The Avernus of the Æneid seems to have been a watering-place of some repute, which was in such immediate proximity to the lower regions, and presented such great attractions on account of being upon the most desirable route thither, that the name came, at

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last, to be applied as much to the sulphurous depths below as to the oak-shaded lake above. Various points of interest in this occidental Avernus have received appellations suggested by the surroundings; and while some other localities on the Pacific coast have been named for public officials, it has not been considered complimentary to attach modern proper names to anything in the vicinity of the Geysers. For this reason the classics have been laid under contribution. The stream into which the main cañon opens is called Pluton River, the gorge is known as the Devil's Cañon, and a sulphurous grotto has been long named for Proserpine.

In gaining a clear idea of the California Geysers, it will be necessary to forget the geysers of Iceland, with their columns of water and capitals of cloud. Upon approaching those upon Pluton River, your first impression is that there has been a great conflagration, and that the fire engines are blowing off steam preparatory to going home. The gorge is lined with masses of smouldering ashes, from which hot steam is being drifted by the wind, and, in some places, you can imagine that the embers are ready to relight. In the bottom of the cañon, turbid and blackened water, from which vapor slowly lifts, is running among the discolored rocks. Here and there, escaping steam hisses, and, in some places, roars like the "exhaust" of an engine.

In other smaller cañons and depressions on an irregular table land, there are like appearances of chemical activity. The rocks in the vicinity are mainly sandstones and silicious slates, which are highly metamorphic. The intermediate varieties are innumerable, all belonging to the Cretaceous Series,* which is largely represented in

* Geology of California, vol. 1, p. 94 et seq.

the northern Coast Range of the State. Two belts of eruptive rock have been observed in this part of the State, one lying thirty miles south, and the other found between the Geysers and Borax Lake, twenty or more miles away. Both are on the line of former volcanic activity, and near both we find many thermal springs.

Besides hot springs, incrustations of sublimed sulphur, pumice, and the light lavas are regarded as traces of volcanic action. These are found in many places in California, and in Nevada. The writer has observed these indications near the summit of the extinct volcano, Shasta. In all cases they point to former igneous activity. Therefore, the steam-springs and the Solfataras may be considered, for all practical purposes, as the poor relations of volcanoes in reduced circumstances. Such are the Geysers.

Upon the 28th of May there had been a slight fall of rain. The morning of the 30th was quite cloudy, the thermometer ranging at eight o'clock from 60° to 62° Fahr. The temperature of the water in Pluton River, immediately above the confluence of the stream from the Devil's Cañon varied from 65° to 70°. At the mouth of the cañon the temperature of the water was 90°, and upon walking up the bank of the stream the different temperatures of 95°, 97°, and 100°, were noticed. A light vapor was rising from the surface of the water.

The first spring where ebullition was observed had a temperature of 135°. There was a free escape of sulphydric acid from the cloudy water, and here the hot, stifling moisture began to make the walk one of discomfort. Upon the right hand several small springs of 190°, all giving off sulphydric acid, were boiling violently, and at the edge of a queer miniature cave on the same side,

there was a furious little cauldron seething at 200°. Several of the springs had low forms of cryptogamic vegetation growing upon the walls of the basins, and, in some instances, confervæ were observed thriving in water of a temperature of 145° Fahr. Seventy or eighty rods from the mouth of the cañon, there is a jet of escaping steam, and a little farther on there is an escape-pipe, nearly ten inches in diameter, through which steam is forced out several feet. Part of the steam condenses at five feet from the orifice, the rest ascends as light vapor, and is borne away by the wind. The greatest degree of temperature observed was 206° Fahr., where there was, of course, as in the other cases mentioned, apparent ebullition from escape of gases. In no instance was the temperature of 500° noticed, which Mr. Bowles* speaks of in his entertaining "Across the Continent." Obviously, this is a slip of a flying quill.

Upon the east and west sides of the cañon, at this point, the ground is made up of decomposing rocks of clayey consistence, and of various colors dependent upon metallic oxides; each little locality seeming to be a laboratory for the decomposition of silicates. Wherever the light soil was dry, there was no vegetation whatever; wherever there was a good degree of humidity, confervoid growths were scattered. Near springs, a few rods farther east, a species of grass, Panicum, was seen growing; and, in one instance, at the water's edge where the panicle was bathed in slowly-rising vapor. This species is abundant near fumaroles, which are little natural blast chimneys, lined with crystalline needles of sublimed sulphur.

* "Across the Continent," p. 282. "They are of all degrees of temperature, from one hundred and fifty to five hundred.

This leads next to the subject of incrustations, which for our purpose we may divide into three groups, namely: silicic acid, sulphates, and sulphur. The first comprises the crystals of quartz, which are found upon slates embedded in the soil. They are minute, but very perfect.

The sulphates, such as crystals of ferric and magnesic sulphate, and the alums were not seen in their best estate. The rain of May 28th had dissolved the largest ones, and while we regretted this loss, we consoled ourselves with the thought that the rain, which had robbed us of our jewels, had added intensity to the chemical action going on around and below. It is stated upon good authority that the action is more intense during, or at the close of the rainy season, which is the winter of California.

The sublimed sulphur presents the two prevailing forms; namely, that which has crystallized with free access of air, and resembles the obtuse oblique rhombic prisms of sulphur familiar to chemists; and that which is produced under pressure, and has a slight inclination of the vertical axis.

In some limited localities there are effloresced salts, and pale, faded carbonates. At one spot, a light green cupric carbonate was partially covered with a darker green confervoid growth, and each shaded into the other like colors on a palette.

But the salts just referred to are those which have been left by the heavily charged water. Imagine, therefore, the variety of dissolved salts which must have been formed, by the over-heated steam and sulphur acids, from the rocks which are being so rapidly leached under pressure. The solutions are, almost in every case, acidulated by a high sulphur acid; free sulphur floats in the water, and

sulphydric acid escapes with violent ebullition. It must be supposed that in these acidulated solutions, the iron exists as a ferrous salt, since sulphydric acid has this reducing power.

In one spring, which is very nearly neutral, the iron has been incompletely precipitated and is suspended, in the agitated water, with other insoluble sulphides.

Another spring is strongly acidulated, and contains only the merest trace of the sulphydric acid, which everywhere fills the atmosphere. The rationale of the reactions observed at the Geysers is not obscure, but so far as the writer is aware, no careful analyses of the waters and sinter have been made upon the spot. The scrupulous care with which the geological survey of California is being conducted, warrants the conclusion that trustworthy examinations will be published in due time.

The writer is unwilling to conclude this imperfect sketch of one of the wonders of California, without bearing his personal testimony to the value of the labors of Professors Whitney and Brewer, and the hard-working corps.

The first volume upon geology has been read and questioned in the presence of the Coast Range and Sierra, from Point Concepcion to the Oregon line, and it has, at all times, proved a reliable guide.

NOTE.—See, also, a very interesting article by Professor F. Shepherd, in "Silliman's Journal" for September, 1851, when the springs were far less easily accessible than now.

THE ENCAMPMENT OF THE HERONS.

BY W. E. ENDICOTT.

An account of an encampment of the Herons may not be uninteresting to such as have never seen one. The herony in question was in Norfolk county, Mass., until the present year; the birds have now, however, taken up their abode elsewhere, because of the almost ceaseless persecution they have suffered. The species was the Night-heron or Quawk (*Nyctiardea Gardeni*). The bird is by no means as graceful as the other herons in figure, being thicker, with a larger and clumsier neck; as to color, however, it is quite handsome, being white, slate, and lilac. It has the long nape feathers characteristic of the herons, rolled, as usual, into the likeness of a tube. The place in which they have hitherto bred is a swamp, wet, and difficult of access, with no turf to set foot on, owing to the shade of the swamp-cedars with which the quagmire is covered, whose slippery, mossy roots furnish a doubtful footing in some cases, and a formidable obstacle in others. The certainty of "slumping" through the moss, thereby going into the thick slime above the knees, the probability of missing one's footing, and going down, full length, on breast or back, and the prospect of hard and disagreeable work in climbing to the nests, are among the allurements to the herons' paradise. The birds undoubtedly built there in 1861, though they were not found until June, 1862, when a gunner, breaking in upon their fancied security, shot over twenty for sport, threw them into a pile, and left them.

All, of course, who cared for natural history, who were few; the idlers, who were more; and many who had

never killed anything larger than a robin, and now were all agog to cover themselves with glory by shooting a quawk, frequented the spot nearly every day during that summer. The first thing which called the attention of the explorer was the whiteness of the ground, owing to the excrements of the birds; the air, hot and close, was loaded with its keen, penetrating odor; the fine particles of it, floating in the air and coming in contact with the perspiring body, made one smart all over. There was also a smell of the decaying fish which lay around, some dropped by accident by the old birds (who, I believe, never stoop to pick them up again), and much more disgorged by the young when their tree was assailed. These fish were mostly such as could not be obtained in the ponds and rivers. I once saw a piece of a pout, and once a fragment of a pickerel, but most of the remains were those of herrings. On the branches of some of the trees I have seen eels hanging with their heads digested off. The rough nests were always built against the trunks of the trees, six or eight feet from the top; and sometimes two, three, or even four might be seen in one cedar. The light-green eggs were usually four in number, but I have seen five and six repeatedly, and, once, seven in a nest. The young are downy, soft, helpless things at first, but soon gain strength enough to climb to the upper branches where they hang on with bill and claws, and are fed by their parents till nearly full-grown. Two broods are often reared in a single year, and it is no uncommon thing to see four or five of the first brood sitting on the tree-top, while the nest below contains as many more of their younger brothers and sisters; both lots, of course, to be fed by their parents. They climb clumsily, and seem, at every step, to be in immediate danger of falling,

yet it is very difficult to dislodge them. When they strike the ground they set off at full speed, and might easily escape did they not croak unceasingly as they run. The first year many of the young were carried away as pets. I kept one several weeks. No confinement was needed, for he had no more idea of running away than my hens had. Early in the morning, and for an hour or two after sunset, he would walk away into the lowlands, but would come back to his perch regularly. He was unable to forage to his complete satisfaction, however, and would sometimes try to catch my young chickens. I then took to fishing for him, and then, to my sorrow, I found out what a heron's appetite is; and thought, with pity, of the poor parent-birds in the swamp with six or eight such maws to fill. Five bream, as large as my hand, were not too much of a meal for him. He would catch them, all alive, out of the tub of water by the middle of the back, toss them up until he got them into the right position, head first down his throat; then he would swallow them by dint of great exertion, his neck presenting a curious appearance, as the fish, four inches broad, passed slowly down, making occasional convulsive attempts to struggle; a proceeding which seemed to enhance the pleasure of the bird. I once gave him a dry dead fish which he got half-way down, where it stuck; he tried and tried in vain to swallow it; then he made equally futile efforts to disgorge; then he turned his eye on me reproachfully and imploringly, so I was fain to take him between my knees, and tip up his bill and pour water down over the fish with a spoon, until the dried-up slime became again moistened, when, with a long pull and a strong pull, the bird engulphed him, gave me an ungrateful peck, and stalked off with a "q-u-a-w-k."

ARTIFICIAL OYSTER CULTIVATION IN FRANCE.

BY F. W. FELLOWES.

In a previous article having briefly described the generation of the oyster, the writer will, in the present one, give an account of the cultivation of this favorite mollusk as practised in France, and notably at the imperial, or model *parcs* in the *bassin d'Arcachon.*

This bay was apparently intended by Nature for an oyster farm, and its rich, firm, muddy bottom has *always* yielded them in vast quantities until about 1840, when, to the regret and astonishment of the fishermen (who had mercilessly dredged them up at all seasons, and had killed the goose that laid the golden eggs), their mine was found to be exhausted; fine, full-flavored oysters that had been heretofore bought for three or four sous the hundred, now readily sold for three francs and upwards, and even with these prices the oystermen were starving.

In 1859, Professor Coste, by order of the emperor, passed the summer at Arcachon, and studied the then unknown subject of oyster cultivation, located the now flourishing and successful *parcs*, and addressed a report to the emperor urging the immediate replanting of these exhausted beds. The following year his suggestions and plans were carried out under the immediate supervision of this naturalist, with surprising and satisfactory results. Here are nearly two thousand acres of excellent bottom for growing oysters, *uncovered* by the tide for an average of two hours at each low-water, and with the mild winter climate of the southerly coast of France, this circumstance is of priceless value, as it enables the laborers to

work among, and even handle the oysters at will, and renders the term "oyster farm" specially applicable to this locality.

A *parc* is regularly laid out like a market garden, into squares of say two hundred feet, a path goes all around and through them, a post is fixed on the corner with the number of the lot painted on it, and a record is kept by the superintendent of what size, quantity, and quality of oysters are planted on each, and his books and stock are inspected at stated intervals. Common curved tiles of baked clay, costing less than a sou a piece, have—after experiments with various contrivances—proved to be the most practical method of catching the drifting "spat." These tiles, or *tuiles* as they are called, were used at first just as they came from the kiln; but it was found that so large a proportion of the "spat" followed with its young shell the inequalities of the surface, grew so firmly to it, and were destroyed in separating them from the tile, that another ingenious plan was adopted. The tiles are dipped into a kind of cement containing sand and hydraulic lime, which, drying in a few minutes, coats them with an evenly rough surface in every way attractive to the "spat." When it is desirable to remove the oysters, a chisel, fashioned to follow the curve of the tile, is easily introduced between it and the oyster, which drops off uninjured.

About the middle of May these tiles are arranged in piles, ten feet long, five feet high, and five feet wide, which structures are called *ruches* or *les ruches tuilées*. These tiles are piled in various ways; usually they are placed with the concave roof uppermost, each layer running transversely across the layers beneath it. The sides of the tiles do not touch, but are separated by about

three inches of space, and often, though not always, adult oysters are laid along in these spaces. When the *ruche* is otherwise completed, heavy stones are placed upon the top to make the mass more solid and safe to resist the action of the stormy waves. Oysters are strewn all around these *ruches*, which are regularly separated from each other by a space of fifteen feet. Between the *ruches* bundles of faggots, or *fascines*, bound together in the middle with galvanized wire, are suspended about one foot from the bottom, by a cross piece made fast on two low posts. When the drifting "spat" is ready to adhere to a suitable object, a very large proportion of it is caught by, or seeks refuge in one or the other of these friendly asylums, and safely grows to the usual merchantable size.

One of Professor Coste's early experiments was with a box a yard square, perforated with holes, containing two shelves with bottoms of coarse wire-cloth. Sixty adult oysters were placed on these shelves and on the mud on the bottom. The sides and top of this box—made in pieces to take apart—were roughed up with an adze to attract and secure the "spat," but this plan was abandoned for two reasons; first, the unavoidable expense, and, secondly, it was found that the "spat," when first evolved, is not ready to adhere to anything, however suitable, but must swim about for a few days; and so the enormous quantity of little ones, given out by the mother oysters in the box, escaped through the holes and located themselves elsewhere. The tiles and the faggots are now in universal use. By the middle of August the oysters have finished their reproductive labors, and begin to fatten again, having become very poor during the summer, but the tiles and faggots are not taken up until a month later.

By that time, all the "spat" has located itself, and the *ruches* are carefully taken apart, each tile being laid down in the same position as in the *ruche*, side by side in long furrows or ditches prepared for them.

There they are allowed to remain until the following summer, when the oysters on the upper side of the tiles are removed and planted in beds, hollowed out about three inches deep, running the length of the *parc;* while the tile is then turned over with the roof-side downwards, and the oysters on the other side are left to grow as they at first fixed themselves, unless, being too much crowded, they grow upon each other, and in irregular shapes; in this case they are thinned out. The writer saw many thousands of tiles in rows, with oysters three years old, and of handsome size, still growing where they first were "set;" but usually they are all removed to the beds the second year, and the tiles, after being redipped in the cement, are again piled as before.

The faggots are taken to some enclosures, which are called *claires*, which are made of solid mason-work, water-tight, where the water can be admitted and excluded at pleasure, and where the waves can have no power, and are there unbound and left to themselves to grow until large enough to be separated from the branches, which is usually six to eight months, when they are treated like those grown upon tiles.

At the end of the third year, the oysters have attained the most desirable size, and are ready for the market. Those grown in the imperial *parcs* are not sold, but are consumed by the emperor, presented by him to crowned heads and friends, either for use or to stock their private *parcs*, or abandoned to the poor fishermen, who on a certain day are allowed to gather them.

The princess Batichiochi, a near relation of the emperor, has a large farm in the bay of Quiberon, and sells oysters to supply the Paris restaurants and others, in large quantities; and, though her farm was only in its third year, it was, as the superintendent remarked with pride and pleasure, more than paying expenses; but *next year!* "*mais l'année prochaine nous ferons des belles affaires, allez!*"

The sale of the yearling seed is made a special business by some oystermen, and they bring from four to six francs the thousand. They are put up in round baskets with a small hole in the top, and are kept, at the season of sale, suspended from scaffoldings erected over the water for the purpose, so that the baskets are never above the surface.

The French oyster-growers are very particular that the oysters taken up for market shall lie for five or six days in the *claires*, before forwarding them to the consumers; this is done in order that all mud and impurities shall be washed out in the pure sea-water, and the oyster is certainly whiter and handsomer for this clean bath.

The *Marennes*, or green oyster, is colored by being placed in *claires* when the tidal water is let out at certain intervals; a confervoid growth is induced which gives the highly prized color and flavor, and doubles the value of the oyster.

The *Ostende* oysters are placed in wooden vats, and are frequently tossed and tumbled about by women with rakes, thus breaking off the thin edge of the new growth of shell, and forcing it to grow more round and deep. Labor, in this country, is much too high to make a remunerative cultivation of the oyster in this manner practicable.

Oyster-growers recognize their own *tuiles* by a sort of trade-mark, which, by French law, it is forgery to imitate. After the *tuile* is moulded, and while still soft, a hole is punched in the top, either round, square, triangular, or of any desired shape; this private mark is recorded in due form, and wherever a tile bearing it is found, it is the unquestioned property of the one who has, so to speak, put his sign manual upon it. Our own laws protecting the oyster-grower need considerable alteration and improvement, especially in the State of Connecticut, where the oyster interest is a very large one; but our legislators, when the subject is properly put before them, will no doubt see the justice of giving the same protection to the marine, as to the cereal farmer, when each invest their money, and conduct their business equally in accordance with the law.

THE QUADRUPEDS OF ARIZONA.

BY DR. ELLIOTT COUES, U. S. A.

(Continued from p. 292.)

FAMILY *Viverridæ*, the Civets, etc. The very curious animal which forms the sole North American representative of this family, containing numerous species in the old world, has been found in so many localities contiguous to Arizona, that beyond a doubt it should be included here, though I am not aware that it has actually been taken in the Territory. The Ring-tailed Civet Cat (*Bassaris astuta*) is a queer animal, combining in itself the features of several distinct groups. Thus it has the ringed tail of a raccoon, the pointed snout and cunning

look of a fox, and the habits, at least in semi-domestication, of a house cat. It is well known to the hunters and miners of California, and by them highly prized as a pet. It is indifferently called "Mountain Cat," "Cat Squirrel," and "Raccoon Fox"; is easily tamed, and makes an interesting pet, as well as a useful one, from its dexterity in catching rats and mice. In a state of nature, it is said to be chiefly nocturnal, and to show spirited fight when attacked. It is about as large as a house cat; above, is yellowish or brownish-gray; below, white; and its tail is annulated alternately with black and white.

Family *Mustelidæ*, the Martens, etc. I am not aware that either of our two North American species of the genus *Mustela* occur so far south as Arizona. Of the Weasels, composing the allied genus *Putorius*, the species most likely to occur are the Bridled (*P. frenatus*), or its Californian representative, *P. xanthogenys*. The common American Mink (*P. vison*), of so very general distribution, may also occur. Hunters have several times described to me an animal they called the "Carcajou,"—which is the Wolverine (*Gulo luscus*),—and their accounts seemed quite pertinent, though I do not venture, upon such doubtful authority, to assert that it is an inhabitant of Arizona. Its existence has not been demonstrated farther south than Salt Lake City. The whole sub-family *Martinæ*, composed of the three preceding genera, is by no means so well represented as the *Melinæ*, comprising the Badgers (*Taxidea*), and the Skunks (*Mephitis*).

The family is chiefly developed in Arizona in these last-named animals, which have attained so unenviable a notoriety from their peculiarly disagreeable odor, believed to be the most powerful and noisome animal stench known. With this drawback, they are certainly beautiful

animals, both in form and colors. The latter are always pure black and white, at least so far as North American species are concerned; and there is a great similarity between them all in this respect. Dr. C. B. R. Kennerly obtained a Skunk at Pueblo Creek, which he says was intermediate in size between *Mephitis mephitica*, and *M. bicolor*. It probably belonged to the former species. Others, well known to occur in Texas, New Mexico, etc., and therefore likely to occur in Arizona, are *M. bicolor*, the little Striped Skunk; *M. varians*, the Texas Skunk; and *M. mesoleuca*, the White-backed Skunk. The first named of these extends across the Territory into California, and quite to the Pacific coast, where I have myself known of its occurrence. It is the smallest of all our species, and the only one which is spotted or streaked. The last is a most beautiful species, well figured by Audubon and Bachman, though under the erroneous name of *M. macroura*. It belongs to a different sub-genus (*Thiosmus*) from the rest, being distinguished by having one less upper molar, and a peculiarity in the position of the nostrils.

Concerning the occurrence of the third sub-family, *Lutrinæ*, I am unable to speak positively. It is most probable, however, that Otters do exist in the Territory, and they may be referable to that species described by Dr. Gray as *Lutra Californica*, which Professor Baird has considered to differ in some appreciable points from the common *L. Canadensis* of the Eastern States.

Family *Ursidæ*, the Bears. The two North American genera of plantigrade carnivora are represented by the Raccoons and the Bears. The former, *Procyon*, differs from *Ursus*, which comprehends the true Bears in dentition, and in many external characters, among which

the most notable are its small size, and elongated tail. I met with no Raccoons in Arizona, and it is doubtful if any exist; though *Procyon Hernandezii*, or that variety of it which Professor Baird has called *P. Mexicana*, from Sonora, may possibly occur.

Bears of at least two species are found, and are not uncommon, at least in all the wooded, and particularly the mountainous portions of the Territory. The vicinity of the San Francisco and Bill Williams Mountains was formerly noted for the numbers of these animals found there, though they appear to have somewhat decreased of late. The southern Rocky Mountains, and the ranges of California, seem to be particularly the home of the huge Grizzly (*U. horribilis*), which becomes less numerous farther north. A variety, characterized as *U. horriæus*, extends into Mexico. The common Black Bear (*U. Americanus*) also includes Arizona in its very extensive range.

Order *Marsupiata*, the Marsupials. A single family and genus (*Didelphys*) represents this remarkable order in North America. The Opossum of the Pacific slope is the *D. Californica*, which differs from *D. Virginiana* in several respects. It is smaller, and darker colored, especially about the head and feet, which parts are almost dusky; besides which the ears are black, blotched with yellow; and the tail also is particolored.

Order *Rodentia*, the Gnawers. This extensive order embraces animals which, by their individual numbers, and their great diversity in form and habit, always constitute a marked feature in the fauna of any country which they inhabit. It is remarkably well developed in Arizona, which has more species of Rodents than of all other orders taken together. If the part these animals play be

less prominent and conspicuous than that of the large carnivores or ruminants, it is not on that account the less interesting. And even in an economic point of view, it is scarcely less important; for the commercial value of the fur of some species, and the destructive agency of others, in field or in warehouse, gives them a consequence to a degree surpassed by no other animals. Aside from these practical considerations, the naturalist finds in this extensive group large room for study and investigation; and the diversity in form and structure and variety in habit exhibited, cannot fail both to please and instruct. The transition from the graceful, vivacious, arboreal squirrels to the clumsy, inactive, terrestrial marmots is great; but no intermediate links in the chain are wanting, and each one is curiously wrought and chased, with a story of its own to tell. Space will allow me to notice in detail only some of the more prominent rodents; and of the others I must perforce "make mere mention."

Family *Sciuridæ*, the Squirrels, etc. The most characteristic, as well as most abundant species of Squirrel, is the Tuft-eared (*Sciurus Abertii*), discovered by Dr. Woodhouse in the San Francisco Mountains. It is one of the largest, and certainly the very handsomest of all our North American species. Besides very beautiful and harmonious colors, it rejoices in the possession of long pointed ear-tufts, extending an inch or more from the edge of the conch of the ear, which give it a peculiarly sprightly and truly elegant appearance. But it is not the case, as generally believed, that these ornaments are constantly present. I do not know what regulates their growth or fall; but certain it is, that under some circumstances, or at certain seasons, they are wanting, either wholly or in part. I have even shot specimens on the

same day, in some of which they were fully developed, and in others wanting. They may possibly be a sexual distinction. Their absence is the main diagnostic point of a *S. castanonotus*, described by Professor Baird,—a supposed species most probably identical with *S. Abertii*, as that eminent naturalist himself now believes.

The pine-clad mountains of northern and central Arizona are the chosen home of this Squirrel; and it rarely, if ever, quits these woods for other situations. It is there a resident species, breeding in abundance, and braving the rigors of winter. Its food is chiefly pine and other seeds, particularly pinoñes, the fruit of *Pinus edulis*, together with acorns of the several species of oaks which grow plentifully in the openings among the pine forests. Considering how seldom it is molested in those wild regions, it is a shy and wary species, and when it discovers an intruder, leaps with great celerity to the top of the pines, whose size and dense foliage in a great measure screen and protect it. It is also a very vigorous and muscular animal, requiring to be "hard hit" before it can be dislodged from its stronghold. Even when mortally wounded, it clings with surprising pertinacity, and for a long time, to its perch. Its cries are much like those of a Fox Squirrel. If wounded and captured, it shows determined fight, and can inflict a severe wound if incautiously handled.

Near the eastern limit of the Territory I one day observed a small squirrel, about the size of our chickaree, running among some rocks and bushes. Unluckily I failed to secure the specimen; but have little doubt that it was the rare and slightly known *S. Fremontii* Aud. and Bach. If this identification be correct, the locality is the southernmost as yet on record for the species.

It is just possible that a western Fox Squirrel (*S. Ludovicianus* Custis, or *S. limitis* Baird) should extend into eastern Arizona; or that *S. fossor* Peale, of California, should reach the Colorado River. These, however, are rather speculative than demonstrated assertions, and await proof.

In addition to the preceding, a true Gray Squirrel inhabits Arizona, which I am inclined to think is a species new to science. It must be quite rare, as I never saw or obtained but a single one,—a female, shot December 20, 1865, at Fort Whipple. In general appearance it is similar to the common Eastern species, with which it agrees closely in the colors of the body; but it is smaller, and at the same time the tail is both relatively and absolutely longer, as well as much broader. It is possible that this may be the species alluded to by Professor Baird, page 263 of his "Mammals of North America," as "Sciurus Carolinensis??", from Santa Catarina, N. M. But his description applies only approximately to my specimen, which I shall describe as new.*

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*SCIURUS ARIZONENSIS Coues, sp. nov.—*Diag.* S. formâ et coloribus corporis Sciuro Carolinensi similis; sed minor, caudâ longiore, latiore, subtus distinctè tricoloratâ.

Description.—Rather smaller than the Eastern Gray Squirrel; of the same form and body-colors; the tail longer, fuller, and much broader. Ears moderate, untufted, both sides furred. Palms 5-tuberculated, nearly naked, but a little hairy on the concavities of the fingers; 4th finger longest, 3d nearly equal, 2d equal to 5th. Soles 6-tuberculated, naked to the heel, but furred rather far around on their sides; 4th toe longest, 2d and 3d nearly equal and but little shorter. Tail to end of vertebræ equalling length of body from nose to root of tail, the hairs projecting 3 1-2 inches beyond terminal vertebra. Above, from nose to root of tail, a uniform mixture of gray, black, white, and tawny; the latter predominating. On the sides of the body, and outsides of the limbs, the tawny and black disappear, leaving a clear grizzle of gray and white. Below, from chin to anus, with the insides of the limbs, pure white; very trenchantly defined against the color of the upper parts and sides. Both eyelids and cheeks about the nose white; woolly space at base of ears ochraceous white. The tail from above is basally of same color as outside of thighs, the tawny of the back stopping abruptly at its base; in the rest of its extent it is black, broadly fringed with white, and having white hairs scattered sparsely through its black portion. Viewed from below, the tail is tricolor, being centrally tawny, bordered with black, which is in turn fringed with white.

Dimensions.—Nose to anterior canthus of eye, 1.1 (inches and tenths); to root of tail 9.5. Tail to end of vertebræ 9.5; to end of hairs 13.0; its width at broadest part fully 6.0. Height of ear .8. Longest whisker 3.3. Palm to end of longest finger with claw 1.6; from olecranon to ditto 3.6. Heel to end of longest toe and claw 2.3; greatest width of sole .7.

Of the Striped Ground Squirrels, or "Chipmunks," composing the genus *Tamias*, only one species is common, which is the Gila Chipmunk (*T. dorsalis* Baird). It is a beautiful little animal, rather larger than the common Eastern one, and conspicuously different in the character of the dorsal stripes. It was first described from the deserts of Southern Arizona, but I found it abundant at Fort Whipple, and it may extend considerably farther north. Unlike most others, it is a rock-loving species, and rarely quits its favorite resorts. Among masses of lava and gneiss it may be seen tripping lightly and gracefully, its pretty tail held arched downward, or flirted from side to side. It is a shy and suspicious animal, though so rarely molested, and scarcely exhibits the familiarity of disposition shown by its Eastern congener. When alarmed, it hurries precipitately to the mouth of its retreat, where, as if conscious of security, it sits and chatters an angry defiance at the intruder. It is a permanent resident around Fort Whipple, but hardly seen during the winter, which it passes in its burrows, in which an abundant supply of food, in the shape of nuts, acorns, and seeds, is laid up during the fall for winter use.

I think that one other species of Tamias—possibly *T. Townsendii*—occurs rarely, but I cannot speak positively on this point. I have no knowledge of the existence of any Flying Squirrels (*Pteromys*) in Arizona.

The genus *Spermophilus*, comprising the true Ground Squirrels, or Squirrel Marmots, is well represented by quite numerous species, though none of them occur in such multitudes as to form the colonies for which some are so noted in other countries.

One of the smallest and the most beautiful of our

Spermophiles is the elegant little *S. Harrisii* of Audubon and Bachman. It is only about as large as a Chipmunk; has stripes which make it look very much like one, and many habits in common with it. The Arizonian species particularly resembles the *Tamias dorsalis* in general appearance, as viewed in life, and frequents precisely the same sort of localities. Though still very rare in collections, it is common enough in Western Arizona, and in fact in the greater part of the desert region about Fort Mojave, on both sides of the Colorado River. I saw a great many at different times in the autumn near Beal's Springs, where I found them in the most rocky and precipitous places. It was difficult to procure specimens, not only from the nature of the region, but on account of their extreme agility, and their unwillingness to venture at any time far from their secure rocky retreats.

The common and notorious California Ground Squirrel (*S. Beecheyi*) ranges eastward across the Colorado valley, though in Arizona it is by no means so abundant as in California, where it forms colonies approaching those of the prairie dog in extent, and is a great pest to the farmer. In the vicinity of Los Angeles, I had an excellent opportunity of studying its habits. On the flat or slightly rolling dry plains which stretch between that town and the sea-beach, it is exceedingly numerous. The burrows occur usually in clusters, and upon little mounds or hillocks of dirt formed by the soil heaped up during their excavation; but single ones are scattered in every direction. Upon these "earth-works" the animals may be seen at all times, sitting upright, and motionless as statues, their fore-paws drooped, and their eyes intently fixed upon the passer-by; or, when no suspicious object appears, lying and basking in the sun, or playing merrily

with each other upon the ramparts of their citadels. I have no doubt that the subterranean passages intercommunicate, and that each animal does not have its own entrance, though he may possess private apartments below. In the vicinity of large encampments, the grass, herbage, and in fact everything green is so closely cropped, that the ground is almost bare; and it becomes a matter for wonder that so many animals can contrive to fill their stomachs. As is the case with those of the prairie dog, the villages are inhabited by a species of burrowing owl, which takes possession of deserted holes. Over the dry plain the graceful mountain plover courses swiftly along; while overhead, or resting upon the ground, is the great squirrel hawk, on the look-out for its prey.

The general manners of these animals call forcibly to mind the prairie dogs. Like them, they hardly venture far from their burrows, to which they hasten precipitately on the first sign of an alarm. Reaching the entrance, they stop a moment in a squat attitude, or rise on their hind-quarters, the better to reconnoitre, venting their displeasure and suspicion by a sharp, chattering bark. They are tough, muscular animals, and must be hard hit to be killed; and even when mortally wounded, will make use of their convulsive death-struggles to reach their burrows, into which they at last drop exhausted, and may be thus lost to the collector.

The Line-tailed Spermophile (*S. grammurus* Say), is another common species, especially of the southern portions, whence it extends into Mexico. It has a peculiar appearance, produced mainly by its tail, calling to mind a true *Sciurus;* so much so, that it has been placed in that genus by some writers, although a true *Spermophilus.*

Observers agree in according to it decidedly arboreal habits. It is both a rock and woods-loving species, and Mr. J. H. Clark, who found it abundant at the copper mines, says it seems to choose its abode mainly with reference to a supply of food, making its burrow indifferently in loose soil, under rocks, or in hollow trees.

The Round-tailed Spermophile (*S. tereticauda* Baird) is a little known species, first described from specimens taken at Fort Yuma, whose precise extent of range remains to be determined. I have not met with it, and believe that no information concerning its habits has been put on record. The chief peculiarity lies in its tail, which is disproportionately long for this genus, cylindrical in shape, and very long-haired. It is among the smaller species, being only about six inches in length of body; is above of a light yellowish-brown, finely grizzled, and below of a soiled yellowish-white.

In addition to the preceding, several Mexican species may very likely extend into the Territory from Sonora. Such are *S. Mexicana*, *S. spilosoma*, and possibly *S. Couchii*. The common little *S. tridecemlineatus*, of the Missouri region, has been found so far south-west as Fort Thorn, N. M., and possibly should also be included. *S. lateralis*, a species closely allied to *S. Harrisii* has been found in the Des Chutes Basin, and may extend as far south as Arizona.

A step further from the true squirrels brings us to the Prairie "Dogs," as they are called; formerly classed with the Spermophiles, to which they are closely allied, but now more properly placed in a distinct genus (*Cynomys*). They mainly differ from the true Spermophiles in the extreme brevity of the tail, the very rudimentary cheek-pouches, and some dental and cranial peculiarities. The

species are strictly terrestrial, and eminently gregarious, being noted for the large colonies which they form. Long as they have been known, and much as has been learned about them, there are many points of their social and individual economy which remain very obscure. Such are those relating to their migrations, their supplies of food and water, their gestation, and their relations with the owls and rattlesnakes found among them. The commonest of our two species, *C. Ludovicianus*, is mainly confined to the great central plains. A second species occurs in Arizona; the short-tailed Prairie Dog (*C. Gunnisonii* Baird), named in 1855 from specimens brought from Coachetope Pass by Capt. Beckwith. It is distinguished from the other by its smaller size, somewhat different colors, and still shorter tail, which is not tipped with black. I was so fortunate as to secure a specimen of this rare animal, near the San Francisco Mountains, in July of 1864. A colony had settled in one of the little open grassy glades which are scattered like oases through that wild and broken region. No owls or rattlesnakes were to be seen, though a species of horned toad (*Phrynosoma Douglassii*) was extremely abundant. Their cries, movements, and general manners were much like those of the common species.

Passing over the marmots proper (*Arctomys*), of which I have no knowledge as Arizonian animals, there only remains to be noticed one more member of the *Sciuridæ*, —the Beaver (*Castor Canadensis* Kuhl). This animal differs in so many essential features, both external and anatomical, as well as in habits, from the family types, that naturalists doubt the propriety of retaining it in its present position. It is found abundantly on all the streams of the Territory. Judging from the accounts of

old trappers, its numbers seem even to have increased of late; owing, doubtless, both to the diminished value of its fur, of which so many articles now take the place, and to the Indian difficulties, which prevent the penetration of the hunter to its abodes. Particularly upon the Rios Salado and San Francisco is it very abundant; and its dams occur, in some places, every few hundred yards. The almost unbroken seclusion of these retreats gives the animals such a sense of security, that they are less strictly nocturnal in working or playing than in most localities. I have frequently seen them swimming about in broad daylight.

An Indian name of this animal, which I do not recall, signifies "little brother," and is given in recognition of that sagacity, or instinct, or reason, as it may be called, which is displayed in its social and domestic economy. But as one writer has well remarked, all that has been said concerning the wonderful intelligence, or even apparent "forethought" of the Beaver, only argues an instinctive knowledge to a degree possessed by a multitude of other animals; and far outrivalled by that required for the construction of many a bird's or insect's nest. Even the humble and despised muskrat builds habitations requiring almost as much constructive dexterity; and, in many of its habits, evinces a "forethought" quite equal to that of the Beaver. The keen pursuit of the Beaver for its money value, and the conspicuousness of some of its works, are the main causes of its unusual notoriety, and of the admiration with which it is always mentioned in trappers' narratives, and naturalists' embellishments of them. — *To be continued.*

THE HOME OF THE BEES.

BY A. S. PACKARD, JR., M. D.

THE history of the Honey-bee, of its wonderful instincts, its elaborate cells and complex economy, have engrossed the attention of the best observers, even from the time of Virgil, who sang of the Ligurian bee. The literature of the art of bee-keeping is already very extensive. Numerous bee journals and manuals of bee-keeping testify to the importance of this branch of agriculture, while able mathematicians have studied the mode of formation of the hexagonal cells,* and physiologists have investigated the intricate, and, as yet, unsolved problems of the generation and development of the bee itself.

In discussing these difficult questions, we must rise from the study of the simple to the complex, remembering that—

> "All nature widens upward. Evermore,
> The simpler essence lower lies:
> More complex is more perfect—owning more
> Discourse, more widely wise,"

and not forget to study the humbler allies of the Honey-bee. We shall, in observing the habits and homes of the wild bees, gain a clearer insight into the mysteries of the hive.

The great family of bees is divided into social and solitary species. The social kinds live in nests composed of numerous cells in which the young brood are reared. These cells vary in form from those which are quite regularly hexagonal, like those of the Hive-bee, to those which are less regularly six-sided, as in the Stingless-bee

* The cells are not perfectly hexagonal. See the studies on the formation of the cells of the bee, by Professor J. Wyman, in the "Proceedings of the American Academy of Arts and Sciences." Boston, 1866.

of the tropics (*Melipona*), until in the Humble-bee the cells are isolated and cylindrical in form.

Before speaking of the wild bees, let us briefly review the life of the Honey-bee. The queen bee having wintered over with many workers, lays her eggs in the spring, first in the worker, and, at a later period, in the drone-cells. Early in the summer the workers construct the large, flask-shaped queen-cells, which are placed on the edge of the comb, and in these the queen larvæ are fed with rich and choice food. The new queens form new swarms. The new-born queen takes her marriage flight high in the air with a drone, and on her return undertakes the management of the hive, and the duty of laying eggs. When the supply of queens is exhausted, the workers destroy the drones. The first brood of workers live about six weeks in summer, and then give way to a new brood. The queens, according to Von Berlepsch, are known to live five years, and, during their whole life, lay more than a million eggs.

In the tropics, the Honey-bee is replaced by the Meliponas and Trigonas. They are minute stingless bees, which store up honey and live in colonies often of immense extent. The cells of Melipona are hexagonal, nearly approaching in regularity those of the Hive-bee, while the honey cells are irregular, being much larger cavities which hold about one-half as much honey as a cell of the Humble-bee. "Gardner, in his travels, states that many species of Melipona build in the hollow trunks of trees, others in banks; some suspend their nests from the branches of trees, whilst one species constructs its nest of clay, it being of large size." (F. Smith.)

In a nest of *Trigona carbonaria*, from eastern Australia, Mr. F. Smith, of the British Museum, found from four

hundred to five hundred dead workers, but no females. The combs were arranged precisely similar to those of the common wasp. The number of honey-pots which were placed at the foot of the nest was two hundred and fifty. Mr. Smith inclines to the opinion that the hive of Trigona contains several prolific females, as the great number of workers can only be thus explained, and M. Guerin found six females in a nest of *Melipona fulvipes.*

At home, our nearest ally of the true Honey-bee, is the Humble-bee (*Bombus*), of which over forty species are known to inhabit North America.

The economy of the Humble-bee is thus: the queen awakens in early spring from her winter's sleep beneath the leaves or moss, or in deserted nests, and selects a nesting place generally in an abandoned nest of a field-mouse, or beneath a stump or sod, and "immediately," according to Mr. F. W. Putnam,* "collects a small amount of pollen mixed with honey, and in this deposits from seven to fourteen eggs, gradually adding to the pollen mass until the first brood is hatched. She does not wait, however, for one brood to be hatched before laying the eggs of another, but, as soon as food enough has been collected, she lays the eggs for a second. The eggs (Plate 10, Fig. 2), are laid, in contact with each other, in one cavity of the mass of pollen, with a part of which they are slightly covered. They are very soon developed; in fact the lines are nowhere distinctly drawn between the egg and the

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*Notes on the Habits of the Humble-bee, Proceedings of the Essex Institute, vol. iv, 1864, p. 101. Mr. Angus thus writes us concerning the habits of *B. vagans.* "I have found the males plentiful near our garden fence, with a hole such as would be made by a mouse. They seem to be quite numerous. I was attracted to it by the noise they were making in fanning at the opening. I counted at one time as many as seven thus employed, and the sound could be heard several yards off. Several males were at rest, but mostly on the wing, when they would make a dash among the fanners, and all would scatter and sport around. The workers seem to be of a uniform size, and full as large as the males. I think the object of the fanning was to introduce air into the nest, as is done by the Honey-bees."

larva, the larva and pupa, and again between the latter and the imago; a perfect series, showing this gradual transformation of the young to the imago can be found in almost every nest.

"As soon as the larvæ are capable of motion and commence feeding, they eat the pollen by which they are surrounded, and, gradually separating, push their way in various directions. Eating as they move, and increasing in size quite rapidly, they soon make large cavities in the pollen mass. When they have attained their full size, they spin a silken wall about them, which is strengthened by the old bees covering it with a thin layer of wax, which soon becomes hard and tough, thus forming a cell. (Plate 10, Figs. 1, 2.) The larvæ now gradually attain the pupa stage, and remain inactive until their full development. They then cut their way out, and are ready to assume their duties as workers, small females, males or queens.

"It is apparent that the irregular disposition of the cells is due to their being constructed so peculiarly by the larvæ. After the first brood, composed of workers, has come forth, the queen bee devotes her time principally to her duties at home, the workers supplying the colony with honey and pollen. As the queen continues prolific, more workers are added, and the nest is rapidly enlarged.

"About the middle of summer, eggs are deposited, which produce both small females and males." . . . "All eggs laid after the last of July produce the large females, or queens, and, the males being still in the nest, it is presumed that the queens are impregnated at this time, as, on the approach of cold weather, all except the queens, of which there are several in each nest, die."

While the Humble-bee in some respects shows much less instinct than the solitary bees mentioned below, it stands higher in the series, however, from having workers, as well as males and females, who provide food for the young. The labors of the Mason-bees, and their allies, terminate after the cell is once constructed and filled with pollen. The eggs are then left to hatch, and the young care for themselves, though the adult bee shows greater skill in architecture than the Humble-bee. It is thus throughout nature. Many forms comparatively low in the scale of life astonish us with certain characters or traits, reminding us of beings much superior, physically and intellectually. The lower forms constantly reach up and in some way ally themselves with creatures far more highly organized. Thus the fish-like seal reminds us strikingly of the dog, both in the form of the head, in its docility and great intelligence when tamed, and even in its bark and the movements of the head.

The parasites of the Humble-bee are numerous. Such are the species of *Apathus*, which so closely resemble the Humble-bee itself, that it takes long study to distinguish them readily. Its habits are not known, other than that it is found in the nests of its host. It differs from the Humble-bee in having no pollen-basket, showing that its larvæ must feed on the food stored up by their host, as it does not itself collect it. The mandibles also are not, like those of Bombus, trowel-shaped for architectural purposes, but acutely triangular, and are probably not used in building.

The larvæ of various moths consume the honey and waxen cells; the two-winged flies, *Volucella* and *Conops*, and the larvæ of what is either an Anthomyia or Tachina-like fly, and several species of another genus of flies,

Anthrax, together with several beetles, such as the *Meloe*, *Stylops*, and *Antherophagus* prey upon them.

The power of boring the most symmetrical tunnels in solid wood reaches its perfection in the large Virginian Carpenter-bee (*Xylocopa Virginica*). This bee is as large, and some allied exotic species are often considerably larger than the Humble-bee, but not clothed with such dense hairs. We have received from Mr. James Angus, of West Farms, N. Y., a piece of trellis from a grape-vine, made of pine wood, containing the cells and young in various stages of growth, together with the larvæ and chrysalids of *Anthrax sinuosa*, a species of fly parasitic on the larva, which buries its head in its soft body, and feeds on its juices. (Plate 10, Fig. 5, tunnel containing pollen and young; 6, the larva; 7, the pupa, of *Anthrax sinuosa*.

Mr. Angus thus writes us regarding its habits under date of July 19: "I asked an intelligent and observing carpenter yesterday, if he knew how long it took the Xylocopa to bore her tunnel. He said he thought she bored about one-quarter of an inch a day. I don't think myself she bores more than one-half inch, if she does that. If I mistake not, it takes her about two days to make her own length at the first start; but this being across the grain of the wood may not be so easily done as the remainder, which runs parallel with it. She always follows the grain of the wood, with the exception of the entrance, which is about her own length. The tunnels run from one to one and a half feet in length. They generally run in opposite directions from the opening, and sometimes other galleries are run one above the other, using the same opening. I think they only make new tunnels when old ones are not to be found, and that the same tunnels are

used for many years. Some of the old tunnels are very wide. I have found parts of them about an inch in diameter. I think this is caused by rasping off the sides to procure the necessary material for constructing their cells. The partitions are composed of wood-raspings, and some sticky fluid, probably saliva, to make it adhere.

"The tunnels are sometimes taken possession of by other bees and wasps. I think when this is the case, the Xylocopa prefers making a new cell to cleaning out the mud and rubbish of the other species. I frequently find these bees remaining for a long time on the wing close to the opening, and bobbing their heads against the side, as if fanning air into the opening. I have seen them thus employed for twenty minutes. Whether one bee or more makes the tunnel, that is, whether they take turns in boring, I cannot say at present. In opening the cells, more than one are generally found, even at this season. About two weeks ago, I found as many as seven, I think, in one."*

The hole is divided by partitions into cells about seven-tenths of an inch long. These partitions are constructed of the coarse dust or chippings made by the bee

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*"Since writing the above I have opened one of the new holes of Xylocopa which was commenced between three and four weeks ago, in a pine slat used in the staging of the greenhouse. The dimensions were as follows: Opening fully 3-8 wide; depth 7-16; whole length of tunnel 6 5-16 inches. The tunnel branched both ways from the hole. One end, from opening, was 2 5-8, containing three cells, two with larva and pollen, the third empty. The other side of the opening, or the rest of the tunnel, was empty, with the exception of the old bee (only one) at work. I think this was the work of one bee, and, as near as I can judge, about twenty-five days' work. Width of tunnel inside at widest 9-16 inch.

For some days this bee has been discharging a great quantity of saw-dust and pollen, which I had collected by placing a vessel under it. It would seem that she had cells constructed also in the opposite side of the hole, and that she removed them to enlarge the tunnel. Among the stuff thrown out, I find a partition of a cell nearly entire. I will enclose you the stuff thus collected, and also some of the first castings.

I have just found a Xylocopa bobbing at one of the holes, and in order to ascertain the depth of the tunnel, and to see whether there were any others in them, I sounded with a pliable rod, and found others in one side, at a depth of five and one half inches; the other side was four inches deep, without bees. The morning was cool, so that the object in bobbing could not be to introduce fresh currents of air, but must have had some relation to those inside. Their legs on such occasions are, as I have noticed, loaded with pollen."

in eating out her cells, for our active little carpenter is provided with strong cutting jaws, moved by powerful muscles, and on her legs are stiff brushes of hair for cleaning out the tunnel as she descends into the heart of the solid wood. She must throw out the chips she bites off from the sides of the burrow with her hind legs, passing the load of chips backwards out of the cell with her fore-limbs, which she uses as hands.

The partitions are built most elaborately of a single flattened band of chips, which is rolled up into a coil four layers deep. One side, forming the bottom of the cell, is concave, being beaten down and smoothed off by the bee. The other side of the partition, forming the top of the cell, is flat and rough.

At the time of opening the burrow, July 8th, the cells contained nearly full-grown larvæ, with some half developed. They were feeding on the masses of pollen, which were large as a thick kidney-bean, and occupied nearly half the cell. The larvæ (Plate 10, Fig. 4) resemble those of the Humble-bee, but are slenderer, tapering more rapidly towards each end of the body.

The habits and structure of the little green *Ceratina* ally it closely with Xylocopa. This pretty bee, named by Say *Ceratina dupla*, tunnels out the stems of the elder or blackberry, syringa, or any other pithy shrub, excavating them often to a depth of six or seven inches, and even, according to Mr. Haldeman (Harris MS.), bores in acorns. She makes the walls just wide enough to admit her body, and of a depth capable of holding three or four, often five or six cells (Plate 10, Fig. 11). The finely built cells, with their delicate silken walls, are cylindrical and nearly square at each end, though the free end of the last cell is rounded off. They are four and a

half tenths of an inch long, and a little over one-third as broad. The bee places them at nearly equal distances apart, the slight interval between them being filled in with dirt.

Dr. T. W. Harris* states that, May 15, 1832, one female laid its eggs in the hollow of an aster-stalk. Three perfect insects were disclosed from it July 28th. The observations of Mr. Angus, who saw some bees making their cells, May 18th, also confirms this account. The history of our little upholsterer is thus cleared up. Late in the spring she builds her cells, fills them with pollen, and lays one or more eggs upon each one. Thus in about two months the insect completes its transformations; within this period passing through the egg, the larval and chrysalid states, and then, as a bee, living a few days more, if a male; or if a female, living through the winter. Her life thus spans one year.

The larva (Plate 10, Fig. 10) is longer than that of Megachile, and compared with that of Xylocopa, the different segments are much more convex, giving a serrate outline to the back of the worm. The pupa, or chrysalis, we have found in the cells the last of July. It is white, and three-tenths of an inch long. It differs from that of the Leaf-cutter bee in having four spines on the end of the body.

In none of the wild bees are the cells constructed with more nicety than those of our little Ceratina. She bores out with her jaws a long deep well just the size of her body, and then stretches a thin delicate cloth of silk drawn tight as a drum-head across each end of her chambers, which she then fills with a mixture of pollen and honey.

* According to a note in MSS. deposited in the Library of the Boston Society of Natural History.

Her young are not, in this supposed retreat, entirely free from danger. The most invidious foes enter in and attack her young. Three species of Ichneumon-flies, two of which belong to the Chalcid family, lay their eggs within the body of the larva, and emerge from the dried larva and pupa skins of the bee, often in great numbers. The smallest parasite, belonging to the genus *Anthophorabia*, so called from being first known as a parasite on another bee, *Anthophora*, is a minute species found also abundantly in the tight cells of the Leaf-cutter bee.

The interesting habits of the Leaf-cutting, or Tailor-bee (*Megachile*), have always attracted attention. This bee is a stout, thick-bodied insect, with a large square head, stout, sharp, scissors-like jaws, and with a thick mass of stout dense hairs on the under-side of the tail for carrying pollen, as she is not provided with the pollen-basket of the Honey and Humble-bee.

The Megachile lays its eggs in burrows in the stems of the elder (Plate 10, Fig. 9), which we have received from Mr. James Angus; we have also found them in the hollows of the locust tree. Mr. F. W. Putnam thus speaks of the economy of *M. centunçularis*, our most common species. "My attention was first called, on the 26th of June, to a female busily engaged in bringing pieces of leaf to her cells, which she was building under a board, on the roof of the piazza, directly under my window. Nearly the whole morning was occupied by the bee in bringing pieces of leaf from a rose-bush growing about ten yards from her cells, returning at intervals of a half minute to a minute with the pieces which she carried in such a manner as not to impede her walking when she alighted near her hole." We give a figure of the Leaf-cutter bee in the act of cutting out a circular piece of a rose-leaf (Plate 10, Fig. 8).

She alights upon the leaf, and in a few seconds swiftly runs her scissors-like jaws around through the leaf, bearing off the piece in her hind legs. "About noon she had probably completed the cell, upon which she had been engaged, as, during the afternoon, she was occupied in bringing pollen, preparatory to laying her single egg in the cell. For about twenty days the bee continued at work, building new cells and supplying them with pollen. . . . On the 28th of July, upon removing the board, it was found that the bee had made thirty cells, arranged in nine rows of unequal length, some being slightly curved to adapt them to the space under the board. The longest row contained six cells, and was two and three-quarters inches in length; the whole leaf structure being equal to a length of fifteen inches. Upon making an estimate of the pieces of leaf in this structure, it was ascertained that there must have been at least a thousand pieces used. In addition to the labor of making the cells, this bee, unassisted in all her duties, had to collect the requisite amount of pollen (and honey?) for each cell, and lay her eggs therein, when completed. Upon carefully cutting out a portion of one of the cells, a full-grown larva was seen engaged in spinning a slight silken cocoon about the walls of its prison, which were quite hard and smooth on the inside, probably owing to the movements of the larva, and the consequent pressing of the sticky particles to the walls. In a short time the opening made was closed over by a very thin silken web. The cells, measured on the inside of the hard walls, were .35 of an inch in length, and .15 in diameter. The natural attitude of the larva is somewhat curved in its cell, but if straightened, it just equals the inside length of the cell. On the 31st of July, two female bees came out, having cut their way through the

sides of their cells." In three other cells "several hundred minute Ichneumons (*Anthophorabia megachilis*) were seen, which came forth as soon as the cells were opened."

The habits of the little blue or green Mason-bees (*Osmia*), are quite varied. They construct their cells in the stems of plants and in rotten posts and trees, or, like Andrena, they burrow in sunny banks. An European species selects snail shells for its nest, wherein it builds its earthen cells, while other species nidificate under stones. Curtis found two hundred and thirty cocoons of a British species (*Osmia paretina*), placed on the under side of a flat stone, of which one-third were empty. Of the remainder, the most appeared between March and June, males appearing first; thirty-five more bees were developed the following spring. Thus there were three successive broods, for three succeeding years, so that these bees lived three years before arriving at maturity. This may account for the *insect years*, which are like the "apple years," seasons when bees and wasps, as well as other insects, abound in unusual numbers.

Mr. G. R. Waterhouse, in the Transactions of the Entomological Society of London, for 1864 (3d series, vol. 2, p. 121), states that the cells of *Osmia leucomelana* "are formed of mud, and each cell is built separately. The female bee, having deposited a small pellet of mud in a sheltered spot between some tufts of grass, immediately commences to excavate a small cavity in its upper surface, scraping the mud away from the centre towards the margin by means of her jaws. A small shallow mud-cup is thus produced. It is rough and uneven on the outer surface, but beautifully smooth on the inner. On witnessing thus much of the work performed, I was struck

with three points. 1st, the rapidity with which the insect worked; secondly, the tenacity with which she kept her original position whilst excavating; and thirdly, her constantly going over work which had apparently been completed. . . . The lid is excavated and rendered concave on its outer or upper surface, and is convex and rough on its inner surface; and, in fact, is a simple repetition of the first-formed portion of the cell, a part of a hollow sphere."

The largest species of Osmia known to us is a very dark-blue species.* We are indebted to a lady for specimens of the bees with their cells, which had been excavated in the interior of a maple tree several inches from the bark. The bee had industriously tunnelled out this elaborate burrow (Plate 10, Fig. 12), and, in this respect, resembled the habits of the Carpenter-bee (*Xylocopa*), more closely than any other species of its genus.

The tunnel was over three inches long, and about three-tenths of an inch wide. It contracted a little in width between the cell, showing that the bee worked intelligently, and wasted no more of her energies than was absolutely necessary. The burrow contained five cells, each half an inch long, being rather short and broad, with the hinder end rounded, while the opposite end, next to the one adjoining, is cut off squarely. The cell is somewhat jug-shaped, owing to a slight constriction just behind the mouth. The material of which the cell is composed is stout, silken, parchment-like, and very smooth within. The interstices between the cells are filled in with rather coarse chippings made by the bee.

*This seems to be an undescribed species. We will call it the wood-boring Osmia (*Osmia lignivora*). It is larger than the *Osmia lignaria* of Say, being just half an inch long. The head is much shorter, and less square than in Say's species. The front of the head below the antennæ is clothed with dark hairs, but above and on the thorax with yellowish ochreous hairs. The body is deep blackish-blue, with greenish reflections.

The bee cut its way out of the cells in March, and lived for a month afterwards on a diet of honey and water. It eagerly lapped up the drops of water supplied by its keeper, to whom it soon grew accustomed, and seemed to recognize.

Our smallest and most abundant species is the little green *Osmia simillima* of Smith. It builds its little oval, somewhat urn-shaped cells against the roof of the large deserted galls of the oak-gall fly (*Diplolepis confluentus*), placing them, in this instance eleven in number, in two irregular rows, from which the mature bees issue through a hole in the gall (Plate 10, Fig. 14. From specimens communicated by Mr. F. G. Sanborn). The earthen cells, containing the tough dense cocoons, were arranged irregularly so as to fit the concave vault of the larger gall, which was about two inches in diameter. On emerging from the cell the Osmia cuts out with its powerful jaws an ovate lid, nearly as large as one side of the cell.

In the Harris collection are the cells and specimens of *Osmia pacifica* Say, the peaceful Osmia, which, according to the manuscript notes of Dr. Harris, is found in the perfect state in earthen cells beneath stones. The cell is oval cylindrical, a little contracted as usual with those of all the species of the genus, thus forming an urn-shaped cell. It is half an inch long, and nearly three-tenths of an inch wide, while the cocoon, which is rather thin, is three-tenths of an inch long. We are not acquainted with the habits of the larva and pupa in this country, but Mr. F. Smith states that the larva of the English species hatches in eight days after the eggs are laid, feeds ten to twelve days, when it becomes full-grown, then spins a thin silken covering, and remains in an inactive state

until the following spring, when it completes its transformations.

In the economy of our wild bees we see the manifestation of a wonderful instinct, as well as the exhibition of a *limited reason*. We can scarcely deny to animals a kind of reason which differs *only in degree* from that of man. Each species works in a sphere limited by physical laws, but within that sphere it is a free agent. They have enough of instinct and reason to direct their lives, and to enable them to act their part in carrying out the plan of creation.—*To be continued.*

EXPLANATION OF PLATE 10.

Fig. 1. A cell of the Humble-bee; natural size, with the pollen mass built upon the top.

Fig. 2. End view of the same cell, showing the three eggs laid in three divisions of the cavity.

Fig. 3. *Xylocopa Virginica*, the Carpenter Bee.

Fig. 4. The larva of *Xylocopa Virginica*, the Carpenter Bee; natural size.

Fig. 5. The nest containing the cells of the same, with the partitions and pollen masses, on which the young larva is seen in the act of feeding; natural size.

Fig. 6. Young larva of *Anthrax sinuosa*; side view.

Fig. 7. Pupa of *Anthrax sinuosa*; side view; natural size.

Fig. 8. The Leaf-cutter Bee (*Megachile*), on a rose-leaf, in the act of cutting out a circular piece.

Fig. 9. Cells of Megachile, in the elder; natural size.

Fig. 10. Larva of *Ceratina dupla*, the little green upholsterer Bee; enlarged.

Fig. 11. Cells of the same in the stem of the elder; natural size.

Fig. 12. Cells of *Osmia lignivora*, new species, the wood-devouring Mason-bee, excavated in the maple; natural size.

Fig. 13. Cells of *Osmia simillima*, the common green Mason-bee, built in the deserted gall of the Oak-gall Fly.

Fig. 14. A single earthen cell of the same; natural size.

Fig. 15. Pollen mass, or bee-bread of *Osmia lignaria*; natural size. It is made up of distinct pellets of pollen, which are probably stuck together with saliva.

PACKARD'S HOME OF THE BEES.

THE CHIGNON FUNGUS.

BY TILBURY FOX, M. D.

NOTHING could more clearly have shown the amount of ignorance of the natural history of minute life abroad amongst the public, and the little trouble people will take to make the most trivial use of their common sense, when a novelty, embellished by plausible description, is presented to them, than the rampant nonsense which has been penned and believed in regard to the so-called gregarinæ infesting certain varieties of false hair. The "chignon controversy" has been one of the most widespread, but at the same time transient sensations of the age: started abroad, it soon reached England, where it bewildered the fashion worshippers of the day. The immediate cause of this hubbub was the appearance in the Hamburg paper *Der Freischütz*, of the 7th of February, 1867, of an article based upon the account given in the "Archiv der Gerichtlich Medicin und Hygiene," and in which we are informed that "Mr. Lindemann professes to have discovered and observed a new microscopical parasite, to which he has given the name of Gregarine. He reports, according to his observations, that the gregarine —a protozoic animalcule—is of the lowest order of development of the animal organism, and is found parasitically within the animal and human body, where it floats about with the blood, by which it is nourished. The most striking instance of the parasitism of the gregarine is said to be its existence on the human hair. The gregarinous hair, however, differs in no way from the sound hair. Only if one looks very closely, little dark brown knots, which are generally at the free end of the hair,

may be distinguished even with the naked eye. These are gregarines. Out of thirty samples of hair procured from a hairdresser in Nishni Novgorod, gregarines were found in seventy-five per cent. And it is well known that the hair used for the chignons of the better half of Russia is bought of the poor peasant women, who are proverbially of dirty habits. Pursuing his inquiry, Mr. Lindemann has discovered that almost every louse has in its interior an enormous number of gregarines, and he convinced himself by further experiments that the gregarines on the human hair are deposited there by lice. He observes that the most favorable conditions for the growth of gregarinæ are light, increased temperature, and a moist atmosphere; and he declares that in the ballroom these are not without their influence on the parasites when they exist on false hair, for they at once revive, grow, and multiply, get disseminated in millions, and in consequence of the increased respiration produced by the exertion of dancing, are inhaled freely into the lungs, reach their specific gregarine nature, and after a while induce disease in the body."

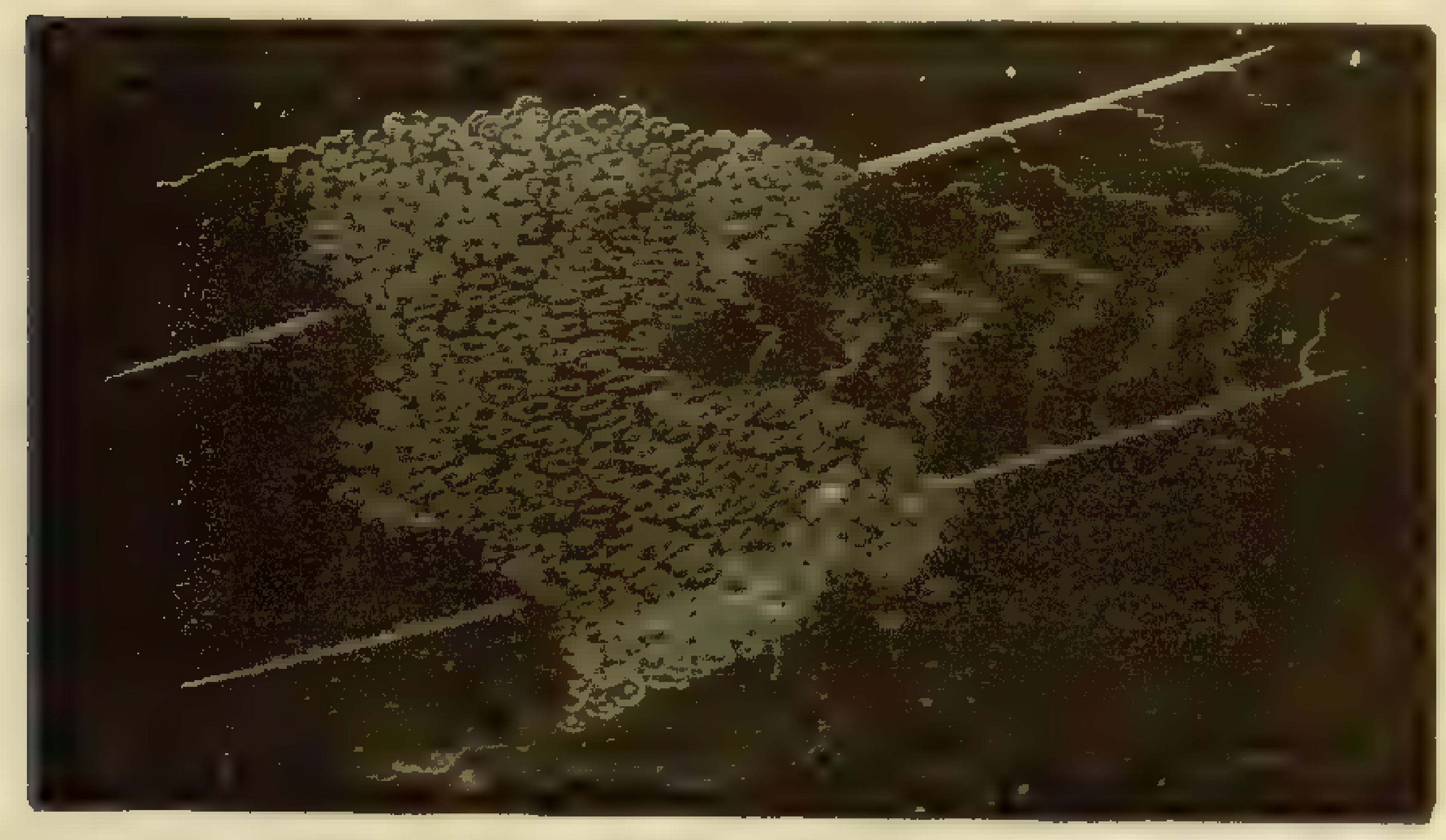
In these quotations prevalent fashions were depicted as sources of danger, inducing discomfort and disease. A writer in one of the daily papers ("Investigator") asserted that he had witnessed from direct observation the development of gregarine into lice, an assumption that implies a liberty with Darwinism that its most zealous and radical devotees would at the present time hesitate to suggest. It is only just to say that the *Lancet*, which first noticed the matter, and confined itself to a mere mention of the facts, urged its readers to accept the statements put forth, with the gravest caution. Lindemann's assertions are very startling to scientific men, because

they are wholly in antagonism with observed facts. Whilst scientific research has as yet afforded little insight of the habits of the lower forms of animal and vegetable life, the revelations of the microscope within the last few years are pregnant with significance as regards their ubiquity, and teach us that we are not to be astonished if we find living forms in unexpected sites, undergoing the most manifold variations in aspect when brought under the play of different influences. At the same time we have the amplest experience to caution us against the acceptance of new species without the keenest criticism. What, then, is the truth in this matter? In my devotion to the subject of diseases of the skin, it has lain in my way during the last ten years to investigate the whole subject of diseases of the hair connected with the development of vegetable parasites, and I think no one has made a larger number of microscopic observations. I have never seen a true gregarina in connection with the hair; but I have recently found a vegetable growth on false German hair answering in naked eye appearances to that described by Lindemann as little dark specks surrounding the hair towards its end. Gregarinæ, according to Lindemann, are made up of cells, which he states to be vegetable, and it is possible that that which I have found may be identical with his gregarinæ. I cannot help thinking that many bodies totally dissimilar in nature have been classed with gregarinæ, which my friend Ray Lankester, than whom no higher authority on the point exists, declares to be truly animal. The growth I have found I now proceed to describe.

If you take a hair on which the parasite exists, and hold it between yourself and the light, towards the outer half you will see one or more, perhaps half a dozen, little dark

knots the size of pin-points, surrounding the shaft of the hair; they are readily felt on drawing the hair through the fingers; they are somewhat difficult to detach. If a hair be placed under the microscope with a quarter-inch objective, the mass will be seen to be made up of cellular bodies surrounding the hair, such as are seen in Fig. 1, kindly drawn for me by Dr. Braxton Hicks, F. R. S.

Fig. 1.



It will be seen that the mass has the appearance of a fungus growth, of which two distinct forms are here present, viz., *mycelial* or *filamentous*, seen in the central part of Fig. 1; and *sporular* or *cellular*, seen in Fig. 2, which is the outer part of Fig. 1.

The hair is apparently healthy, and if the slide be pressed the mass will break away from the hair on either side, bringing away with it more or less of the cuticle, and leaving behind a healthy shaft. The cells are seen to be of various shapes and sizes. Fig. 3 gives a good representation of them; they are from $\frac{1}{4000}$ to $\frac{1}{3000}$ inch; many are like the torula cells developed from Penicillium. Others are larger, undergoing division very actively; they may be subdivided into two, three, or four parts, or much more freely. This indicates the assumption by the parasite of an algal condition. In watching the mass on the hair carefully, it is evident that

Fig. 2.

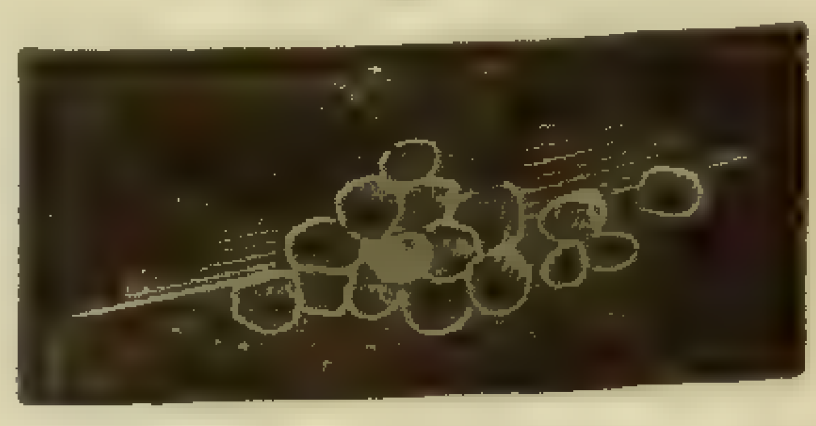
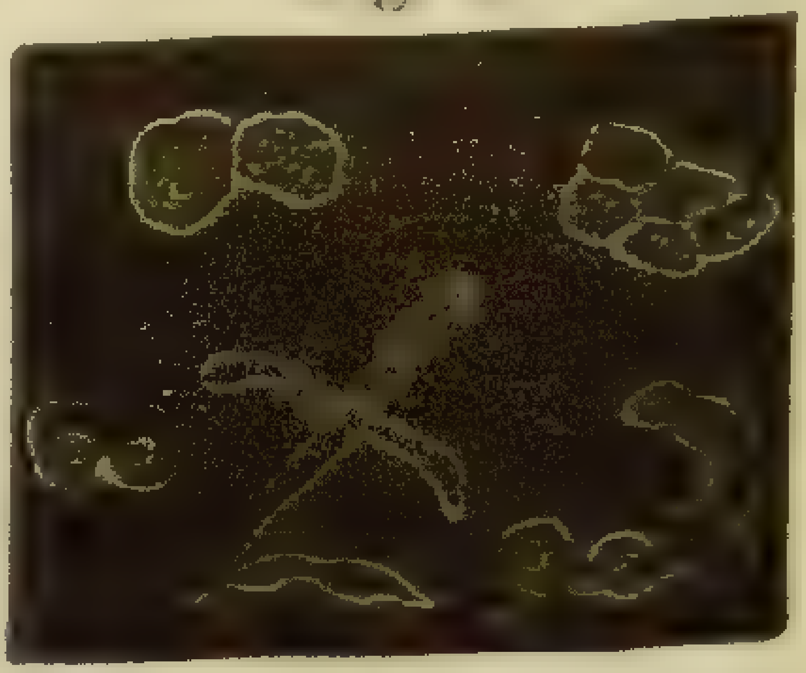
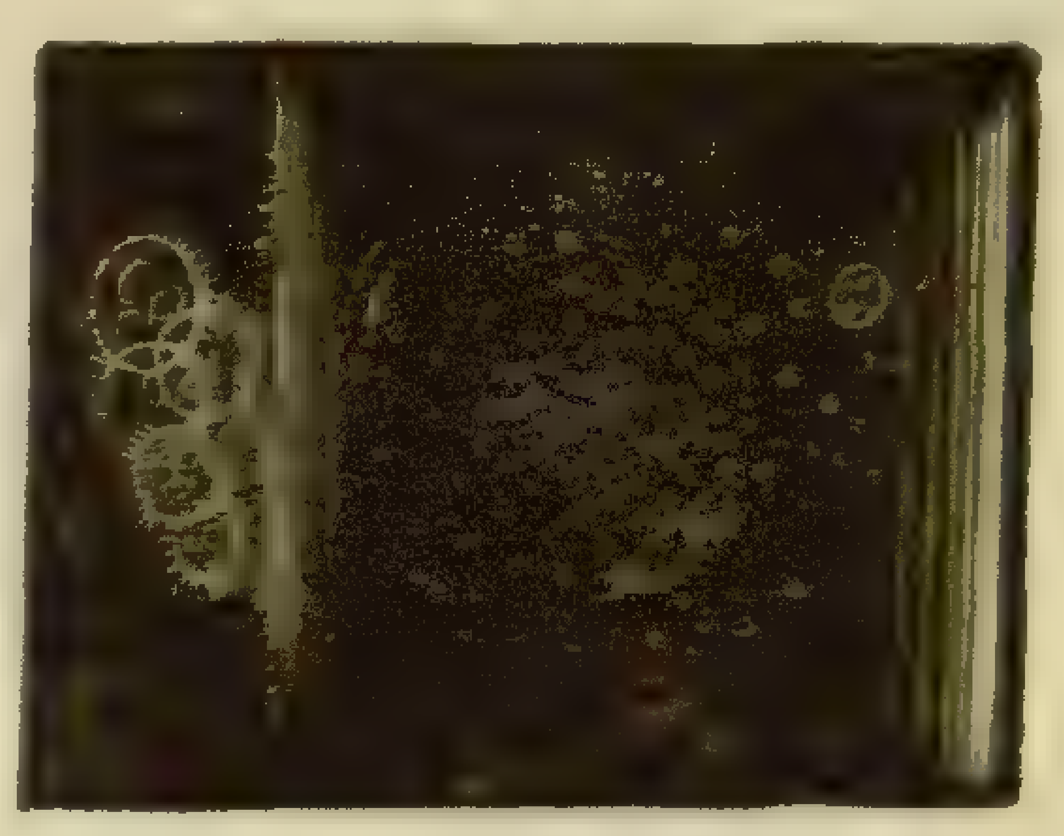


Fig. 3.



a number of cells become detached from the outer or sporular form, and at once move actively about. These small cells indicate an active growth by subdivision, and a fruitful source of propagation; they subsequently become the cells seen in Fig. 3. Certainly this variety of fungus so far described is the most active growth I have come across in my researches, and I have been enabled to germinate it most successfully, so as to set all questions as to its nature completely at rest. Placed under favorable circumstances in water, the spores (Fig. 3) enlarge considerably, and the mycelial filaments increase also; but there is at this time to be observed a very remarkable occurrence, though not in all cases. Some of the large cells in Fig. 1, have become filled with smaller cells; and in others, in addition to these, processes have been put forth from the circumference of the walls in a radiating manner; in other cases the enlarged cells have two long cilia attached to them, by which they move about rapidly, whilst a part of the hair, previous to this free from the fungus, has become dotted all over by minute cells similar to those seen in the interior of the larger ones. All this is seen in Fig. 4.

Fig. 4.

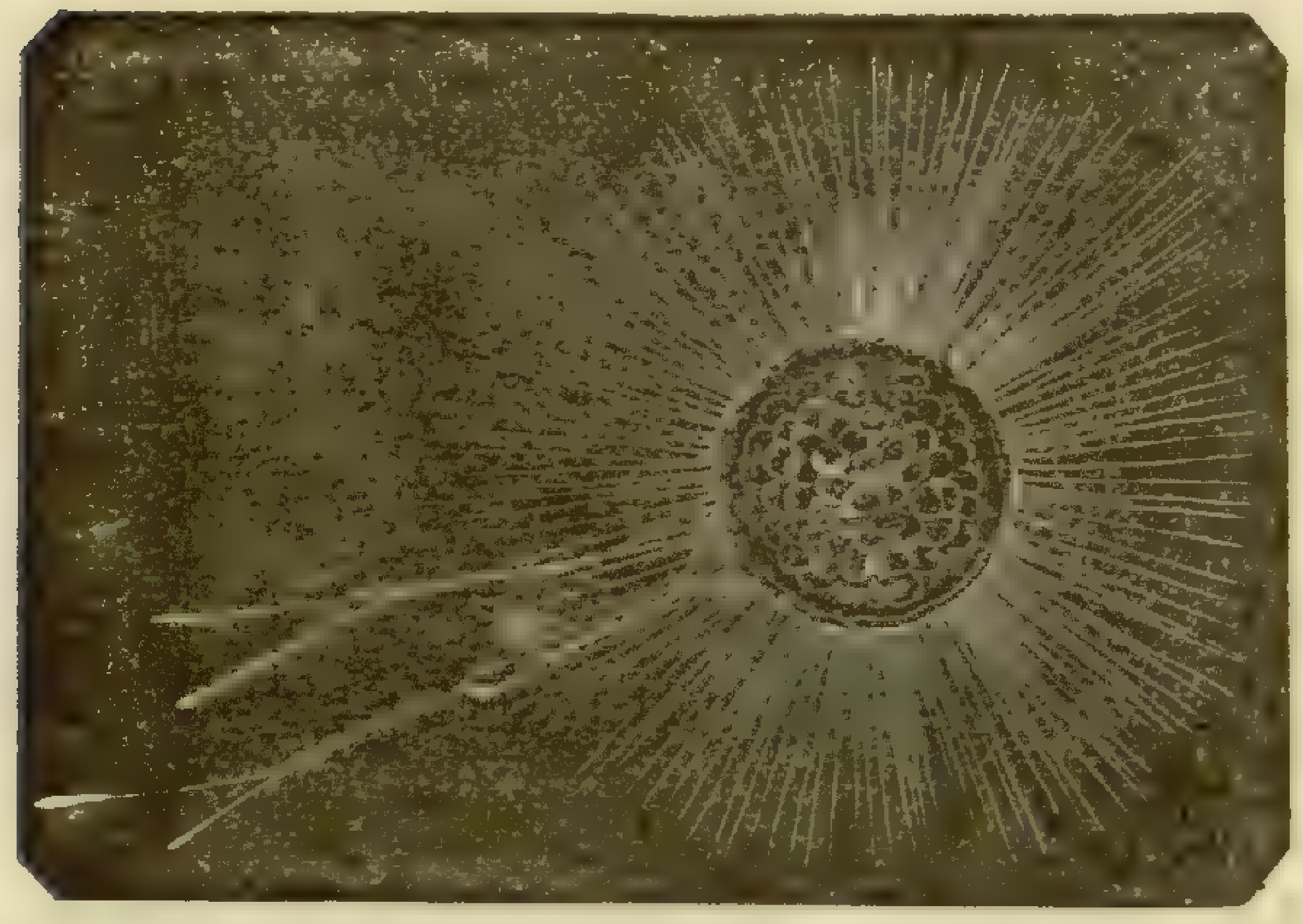


But more than this, I have observed most distinctly large cells filled with smaller cells, furnished with exceedingly delicate radiating processes and putting forth pseudopodia. One of these cells of large size is represented in Fig. 5.

It will here be seen to have assumed the features of an amæboid body. Nothing could have been more distinct to myself, and those who were observing with me, than

this peculiar form; and it seems to me that we have here a pretty complete history of the life of this fungus,—namely, the sporular subdividing and assuming an algal form, which in turn becomes amœbiform, and furnishes ciliated cells that supply the earliest condition of the fungus, as seen in Fig. 4, scattered over the hair.

Fig. 5.



But not satisfied with these results, I set to work to grow the fungus in sugar and water, under constant observation. A rapid enlargement of the sporular cells took place, as in the former case, and in some of the larger cells the most distinct circulation of the granules around the inner circumference of the parent cell was witnessed by myself and my friends, and a beautiful object it was. Finally, I obtained a result similar to the former one.

Fig. 6 represents the appearance of the fungus at the end of fourteen days, seen with an ½ inch object-glass.

Fig. 7 is a portion of the mycelium, taken from the part over the hair, more highly magnified with a 1-12th object-glass.

The ends of the filaments seen in Fig. 8 are analogous, in fact identical with those forms which I have figured in my work on *parasitic diseases of the skin* as resulting from the growth of *oidium*. The globose head contains spores, and is an early stage. The double cell figured in the centre was of a green color like many others.

Accompanying these appearances were, as in the former case, cells—filled with smaller cells and granules in ac-

Fig. 6.

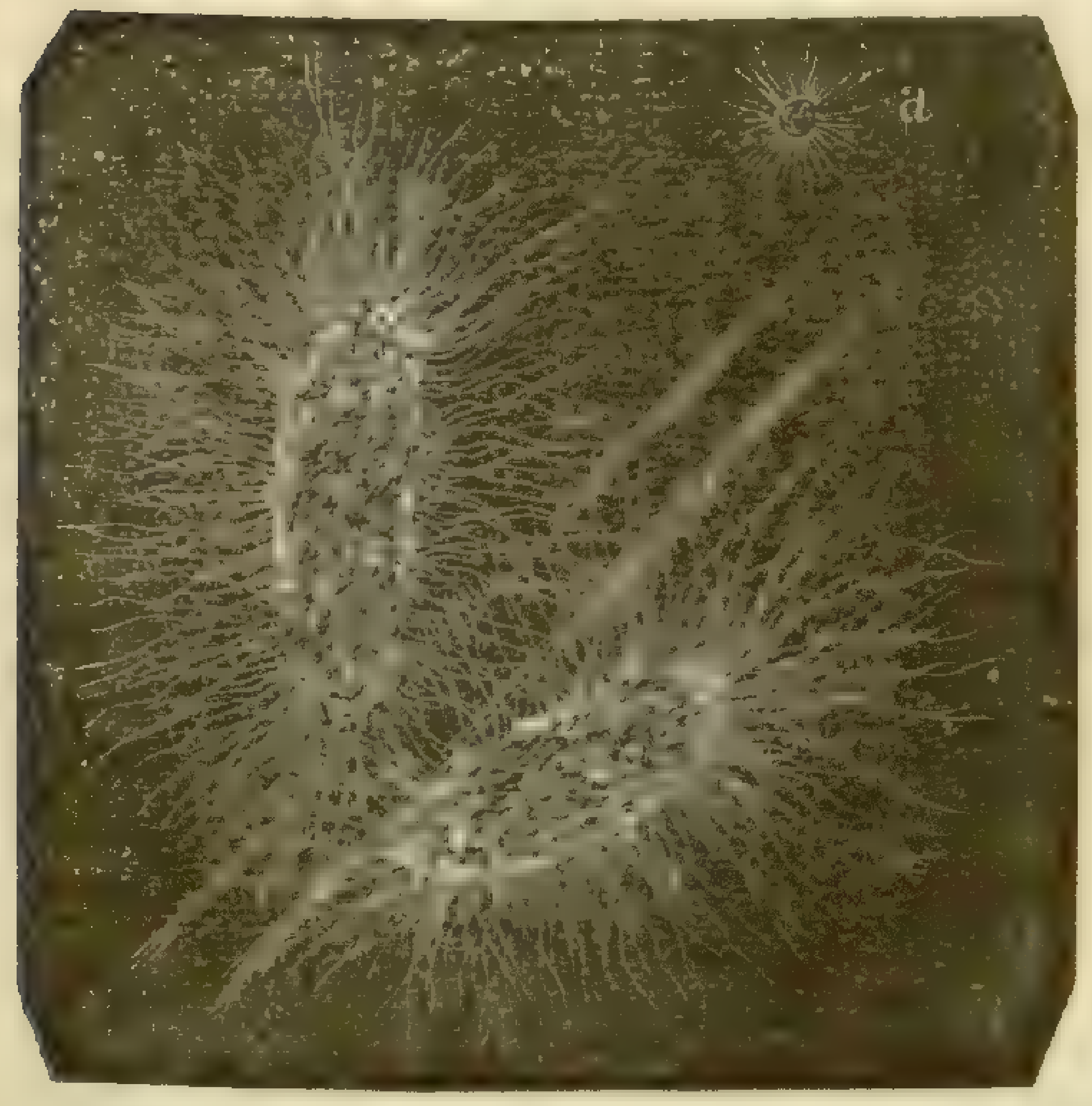


Fig. 7.

tive motion—furnished with cilia, and bodies undergoing the "amœboid" transformation, as seen in Figs. 9 and 10, with 1-12 inch Powell and Lealand.

Here, again, we have the growth taking on an algal

Fig. 8.

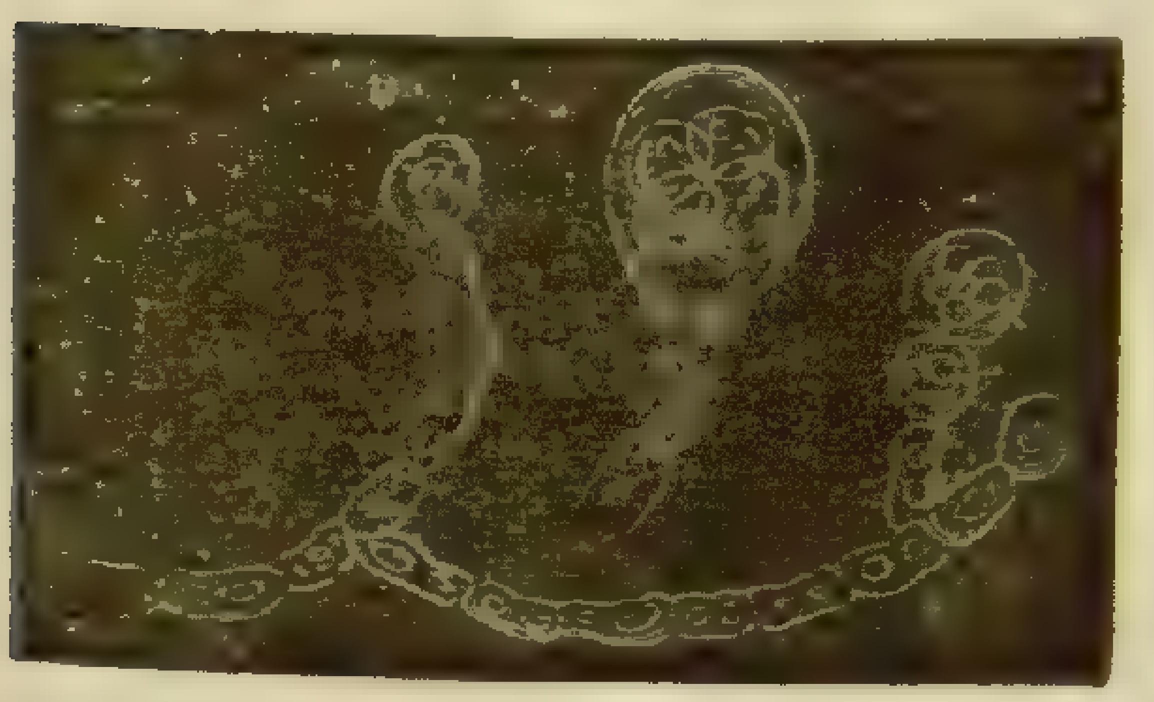


Fig. 9.

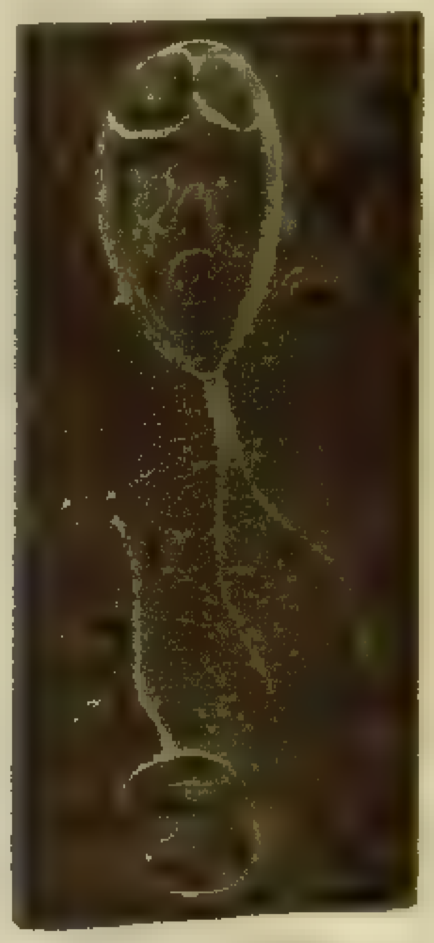


Fig. 10.

phase in one direction, and fructifying into a perfect fungus on the other hand. The drawings I have given were made on the spot from the microscopic objects, and I

must do the artist credit to say he has most faithfully and cleverly portrayed the actual appearances presented by the parasite. The observations now recorded are in complete harmony with those of Dr. Braxton Hicks on the Volvox, and De Bary in his work published in 1864, at Leipsic, "Die Mycetozoen, Ein Beitrag zur Kentniss Der Neidersten Organismen," and are completely confirmatory of the opinion before advanced by myself, that the fungi found upon or within man belong to one genus, and undergo an infinity of variations under different circumstances. In the present case the fungus approaches to the character of Torula rather than any other. There are many most interesting questions that cannot be discussed here. The only one I need refer to is the influence which this species of parasite has in the production of disease. In the immediate condition in which we find it on the hair it need cause but little anxiety; but the minute form as seen in Fig. 4, transplanted to a suitable soil—and the scalp of delicate children best furnishes it—would produce disease of the scalp: of that I have no doubt. Luckily, the tissues of adults, namely, those who wear chignons, are not prone to the more severe forms of diseases produced by vegetable parasites; and as the mass of false hair used in England is free from the fungus described above, the total danger, on the whole, is slight. —*Hardwicke's Science-Gossip.*

NOTE.—*Torula*, *Penicillium*, and *Oidium* are microscopic genera of fungi. The word algal is derived from *alga*, a sea-weed, of which there are many minute species. *Pseudopodia* is derived from the Greek, meaning "false-feet;" they are the organs of locomotion, being mere extensions of the side, or walls of the body of Infusoria. In Fig. 5 they radiate like hairs from the body of the plant. *Amœba* is a low Infusorium, or Rhizopod.

REVIEWS.

An Elementary Treatise on American Grape Culture and Wine Making. By *Peter B. Mead.* Illustrated with nearly two hundred engravings, drawn from nature. New York, 1867. Harper & Brothers. 8vo.

This is a carefully prepared work, and we are informed by those who are specially interested in Grape Culture that it contains much valuable information. Mr. Meade has certainly shown that he was well prepared for the task before him. Besides the several chapters on Climate, Location, Soil, Manures, Laying out and Planting a Vineyard, Training on the various Systems, Planting and Propagation, etc., etc., there is a full chapter devoted to the Diseases and Insects to which the Vine is subject, with figures of the various species of insects. The article on "Mildew" treats of some of the causes and the prevention of this destructive fungus-disease in a comprehensive manner. The chapter on Wine-making also contains much of scientific interest, with an account of Pasteur's experiments, by which he shows that "souring," "acetification," "mould," etc., are each produced by a different vegetable parasite or fungus, which, if allowed to go on to mature growth, will spoil the wine, but which is prevented by heating. This heating does not injure the wine, but actually, according to M. Pasteur, has the effect of hastening its ripening, and bringing forth in a few hours those fine qualities that have heretofore only been secured by long and careful keeping in good cellars.

Annual Report of the Trustees of the Museum of Comparative Zoölogy, Cambridge, together with the Report of the Director, 1866. Boston, 1867. 8vo, pp. 37.

This Report of the Cambridge Museum is mainly taken up with an account of the Thayer Expedition to Brazil, under the charge of Professor Agassiz. The additions from this source consisted largely of fishes and reptiles. "Of fishes alone, no less than 50,000 specimens were actually counted, representing over 2,200 species, the majority of which, say 2,000, are probably new to science and to our collections. This estimate does not include the smaller specimens, less than two inches in length, which also number many thousands." The reports of the assistants, Messrs. A. Agassiz, P. R. Uhler, J. G. Anthony, and N. S. Shaler, show that good progress had been made in their departments.

A second number of the Illustrated Catalogue, The North American

Acalephæ, by Mr. Alexander Agassiz, has been printed and distributed. The third number will contain Professor Agassiz's Report on the Coral Reefs of Florida, originally prepared for the use of the Coast Survey, the latter part of which will be finished by Mr. Theodore Lyman.

Collections of several classes of animals have been sent to naturalists, abroad and at home, for study and identification, many of which were sent from the Brazilian Expedition, though unfortunately lost.

The practice of scattering among naturalists the material for study, a system now pursued by nearly all museums, public and private, illustrates the mutual dependence of museums, and those engaged in the study of science. The benefits are not local, but are shared by all, and not in one country alone, but throughout the scientific world. Thus, a large museum carried on in the interests of the highest education, must do much towards uniting all men in interpreting the marvels of creation.

Already in this country the value of maintaining large museums is widely felt. We cannot afford to stint any of our educational institutions. We cannot have too many scientific schools, or too many museums, and money applied to their endowment will surely tend to enrich the nation, as well as advance good learning and the broadest culture.

THE AMERICAN BEE JOURNAL AND GAZETTE. Edited and published monthly, by *Samuel Wagner*, Washington, D. C. 8vo, $2 a year.

With the July number this important journal begins a new volume, and in an improved dress. It has been steadily gaining in interest and permanent value. No bee-keeper, or student of insects, can do without this work. We hope the circulation will be largely increased, and that the growing interest in so remunerative a branch of agriculture as bee-keeping will enable it to be a success.

NATURAL HISTORY MISCELLANY.

BOTANY.

A SUPPOSED NEW COLUMBINE, AND A NEW OX-EYE DAISY. — On the 15th of May, 1866, I found on the heights west of the Hudson, and opposite the city of Poughkeepsie, N. Y., a cluster of wild Columbine (*Aquilegia*), with all the flowers of a delicate yellow color. I preserved a specimen for my herbarium, and sent a specimen, still fresh, to Professor Gray, of Harvard College. He wrote me that he had seen an approximation to this variety, "but never before one in which the

red or purple was wholly absent." On the 17th of May this year, 1867, I found the same variety again, near the same place where I found it last year. Is it probable that it is a well-marked variety, or perhaps a new species? I shall try to raise it from the seed, and the readers of the NATURALIST shall in due time be notified of the result. Meanwhile I call it the yellow-flowered Columbine (*Aquilegia flaviflora*).

On the 8th of June, 1867, several specimens of a new form of Ox-eye Daisy (*Leucanthemum*) were gathered in the fields of Hon. Matthew Vassar, of Poughkeepsie, N. Y., two of which were kindly sent to me. At first I thought that the plant could be nothing more than a curious form of *Leucanthemum vulgare* Lam., that it was nothing more than the result of a mere freak of nature; and when, on the 10th inst., I went in search of more specimens, I half expected to find the new form and the common one growing on one and the same stem. But although I found specimens by scores, not a stem among them all had the two forms upon it. Nor do the two forms in any observed case—and I have observed many—come from the same root, although the roots of this and the common form grow promiscuously together, and often so near as to touch each other.

The two prominent characters which distinguish this daisy from *L. vulgare*, are the following, namely: *its ray flowers are all tubular, unequally* 4–5-*lobed*, in some cases only 3-lobed, and *the receptacle*—so far as observed—*very convex;* the stem is also more constantly naked above than in the common one. Having sought in vain for any mention of this form in botanical works, and believing it to be new to science, I have ventured to name it *Leucanthemum tubuliflorum*, or the Tubular-flowered Leucanthemum.

Yesterday, June 13th, I revisited the locality of this flower, and brought home specimens enough for all of my class in botany,—over a hundred in number. I would only add, that I have received a letter from Professor Gray, to whom I sent specimens of the daisy, in which he informs me that while he does not regard it as a new species, he will introduce it into his Manual of Botany as a variety, adopting the name I have given it.—SANBORN TENNEY.

Change of Color in Flowers placed under Glasses of different Colors.—M. De Candolle suggested the construction of experimental green-houses and hot-houses, and gave his views as to the plan to be adopted in their erection, so as best to serve the purpose of the physiologist. "A building, such as I propose, would allow of light being passed through colored glasses or colored solutions, and so prove the effect of the different visible and invisible rays which enter into the composition of sunlight. M. Von Martin placed some plants of *Amaranthus tricolor* for two months under glasses of various colors. Under the yellow glass the varied tint of the leaves was preserved. The red glass impeded the development of the leaves, and produced, at the base of the limb, yellow instead of green; in the middle of the upper surface, yellow instead of reddish brown; and below, a red spot instead of purplish red. With the blue glasses, which allowed some green and yellow to pass, that which was red or yellow in the leaf had spread so that there remained only a green border or edge. Under the nearly pure violet glasses, the foliage became almost uniformly green. Now that plants with colored foliage are becoming fashionable, it may interest horticulturists to know that by means of colored glasses, provided they are not yellow, they may hope to obtain, at least, temporary effects as to the coloring of variegated foliage. Nothing would be easier than to create in the experimental hot-house an atmosphere of carbonic acid gas, such as is supposed to have existed in the coal period. Then it might be seen to what extent our present vegetation would take an excess of carbon from the air, and if its general existence were inconvenienced by it. Then might be ascertained what tribes of plants could bear this condition, and what other families could not have existed, supposing the air had formerly had a very large proportion of carbonic acid gas."—*Quarterly Journal of Science, London.*

ZOÖLOGY.

The Stuffed Whale in the Swedish Museum.—Professor Lilljeborg describes, in a letter to Dr. J. E. Gray, how this species of whale (*Balæoptera*) was stuffed, which we translate as follows. The skin of the same was divided into several portions, and then stretched over a model made of wood of the exact form and size of the animal itself. The epidermis is preserved on the skin, and it is still but slightly torn. The layer of blubber is without doubt very thin, otherwise the skin (*epidermis*) would have been filled with rents and wrinkles, which, however, are not to be seen.—*Annals and Magazine of Natural History.*

THE EGGS OF THE DRAGON-FLY.—Since printing the article on the Dragon-fly in our last number we have had an opportunity of seeing the eggs collected by a friend at Haverhill, July 3d, at the first field-meeting of the Essex Institute. The eggs are laid in immense numbers in long ropy, gelatinous masses, nearly one-half an inch thick, attached to an aquatic grass. When folded together, the entire mass was nearly the size of a hen's egg.

The new-born larvæ looked like small spiders swimming in the water, as the abdomen is very short, and the legs remarkably long, the hindermost pair being one-half longer than the body. The body is very transparent, and through the thin wall can be seen the blood coursing rapidly through the dorsal vessel or heart, and returning along the side of the body, as also the smaller currents thrown into and returning from the legs. The little creatures are very active, swimming by hundreds through the water, or crawling over the mass of eggs.

We shall speak at another time of the changes the embryo undergoes before hatching. The eggs are only two and one-half hundredths of an inch long. It is probable that they are the young of Diplax, as they bear a close resemblance to the pupa (fig. 4) figured in our last number.

RAPID CHANGE OF COLOR IN FISH.—I caught the other day in fishing for shells, a small "horned-pout," about two inches long, intensely black in color. I put him in a white bowl to examine him. In half an hour he had turned white, so clear and pretty in color, that you could see the circulation under the skin of the body. Only his "feelers" and eyes remained black, and he is now, three days after capture, lively, healthy, and well bleached. Do these fish usually change their color in this way?—E. C. BOLLES, *Portland, Me.*

NATURAL HISTORY CALENDAR.

INSECTS IN SEPTEMBER.—Few new insects make their first appearance for the season during this month. Most of the species which abound in the early part of the month are the August forms, which live until they are killed by the frosts late in the month. From this cause there is towards the end of the month a very sensible diminution of the number of insects.

The early frosts warn these delicate creatures of approaching cold. Hence the whole insect population is busied late in the month in looking out snug winter quarters, or providing for the continuance of the

species. Warned by the cool and frosty nights, multitudes of caterpillars prepare to spin their dense silken cocoons, which guard them against frost and cold. Such are the "Spinners," as the Germans call them, the Silk-moths, of which the American Silk-worm is a fair example. The last of September it spins its dense cocoon, in which it hybernates in the chrysalis state.

The larvæ of those moths, such as the Sphinges, or Hawk-moths, which spin no cocoon, descend deep into the earth, where they lay in rude earthen cocoons.

The wild bees may now be found frequenting flowers in considerable numbers. Both sexes of the Humble-bee, the Leaf-cutter Bee, and other smaller genera abound during the warm days.

One's attention during an unusually warm and pleasant day in this month is attracted by the clouds of insects filling the air, especially towards sunset, when the slanting rays of the sun shine through the winged hosts. On careful observation these insects will prove to be nearly all ants, and, perhaps, to belong to a single species. Looking about on the ground, an unusual activity will be noticed in the ant-hills. This is the swarming of the ants. The autumnal brood of females has appeared, and this is their marriage day.

The history of a *formicarium*, or ant's nest, is as follows: The workers, only, hybernate, and are found early in spring, taking care of the eggs and larvæ produced by the autumnal brood of females. In the course of the summer these eggs and larvæ arrive at maturity, and swarm on a hot sultry day, usually early in September. The females, after their marriage flight, for the small diminutive males seek their company at this time, descend and enter the ground to lay their eggs for new colonies, or, as Westwood states, they are often seized by the workers and retained in the old colonies. Having no more inclination to fly, they pluck off their wings and may be seen running about wingless.

The autumnal brood of Plant-lice now occur in great numbers on various plants. The last brood, however, does not consist exclusively of males and females, for of some of the wingless individuals previously supposed to be perfect insects of both sexes, Dr. W. I. Burnett found that many were in reality of the ordinary gemmiparous form, such as those composing the early summer broods.

The White Pine Plant-lice, *Lachnus strobi*, may be seen laying their long string of black oval eggs on the needles of the pine. They are accompanied by hosts of two-winged flies, Ichneumons, and in the night by many moths which feed on the Aphis-honey they secrete, and which drops upon the leaves beneath. — A. S. P.

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THE QUADRUPEDS OF ARIZONA.

BY DR. ELLIOTT COUES, U. S. A.

(Continued from p. 363.)

FAMILY *Saccomyidæ*, the Pouched Rats. This is a curious and interesting family of Rodents, represented in Arizona by quite numerous species. Its several genera differ to a remarkable degree in external characters, but agree in the possession of very large cheek pouches, opening outside the small mouth, and capable of enormous extension; and in numerous anatomical features. Two subfamilies exist in North America,—the *Geomyinæ*, and the *Saccomyinæ*. The former includes the "Gophers" or "Salamanders" or "Pouched Rats," as they are variously styled in different sections. They are clumsy, thick-set animals, with large heavy heads, short thick necks, small inexpressive features, short tails, and very strong muscular legs, armed with large claws, eminently fitted for digging. They are also wholly nocturnal, and live in subterranean galleries which they excavate. The *Saccomyinæ*, on the other hand, are elegant in shape, of pleasing colors, and graceful motions; and though par-

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tially subterranean and nocturnal, often come abroad in the daytime. They are known in the vernacular as "Kangaroo" or "Jumping" Rats and Mice, and are entirely confined to Transmississippian regions. The largest species is about as big as a third-grown rat, while the smallest is among the most diminutive of all our animals, unless some of the shrews are still less in size. These animals have well-formed bodies, very large and muscular thighs, small hands, large rounded ears, full protuberant eyes, and very long tails, often tufted at the end. Their fur is peculiarly soft and lustrous.

The two genera of the *Geomyinæ*, though very similar to each other, are distinguished, among other features, by the absence in *Thomomys* of the deep central longitudinal grooves in the upper incisors which exist in *Geomys*. The latter is hardly known west of the Rocky Mountains, nor the former to the eastward of them. Though two other species may occur in Arizona (*Thomomys bulbivorus* from California, and *T. umbrinus* from Sonora), only one, the Red Sand-rat (*T. fulvus*) is at all common. It was discovered by Dr. Woodhouse in the vicinity of the San Francisco Mountains, where it is exceedingly abundant. It lives mainly in light sandy or loamy soil, such as may be readily excavated. The soft soil of grassy hill-sides, or sloping meadows, especially in the vicinity of oaks, or clumps of nut-bearing trees, are favorite resorts, as it finds there an abundance of acorns, seeds, and grasses, upon which it feeds. The succulent stems and roots of many herbs also furnish it with food. Wherever it takes up its abode, little piles of fresh moist earth may be seen in every direction, sometimes scores within a radius of as many yards. These are especially noticeable in the morning, for the animal is strictly

nocturnal, never working, and rarely venturing from its burrow in the daytime. During the night it is very industrious, both in collecting food and in enlarging its galleries; and the amount of fresh earth visible one day, where none had been the day before, is sometimes astonishing. Should Arizona ever become a cultivated region, this gopher would be wellnigh as great a pest to the farmer as the *T. bulbivorus* and *Spermophilus Beecheyi* are in California. We were much annoyed by their digging around, and partially undermining our tents, causing the canvas flooring to slump in when trodden upon. Pouring water in their holes, or plugging them up with sticks, seemed to take effect mainly as a provocation to them to dig others. Though thus daily "bored"—literally and figuratively—by these beasts, I never saw one in a state of nature, and only procured two specimens in as many years. It is notorious that a person may live surrounded by them for years, and never see one, so timid and retiring are they, and so strictly nocturnal.

The Pouched Kangaroo Rat (*Dipodomys Ordii*) is the main representative of its subfamily in Arizona, and extends also over New Mexico, Texas, and part of Mexico. A closely allied species (*D. Philippii*) replaces it in California. It is one of the most abundant of the Rodents about Fort Whipple, where it more nearly takes the place of the house rat and mouse than any other native species, except an *Hesperomys*, to be presently noticed. It is beautiful in form and colors, and its motions are agile and graceful. Above, it is of a clear fawn color, deepening along the middle of the back into brownish gray; the whole under parts are pure silvery white, which color also forms an artistic contrast to the fawn, by striping the head and thighs. The long tail, tufted near the end,

is mouse-gray above and below, and pure white on its sides. The fur is peculiarly soft, smooth, and lustrous. It chiefly inhabits loose sandy soil, like a gopher, though its "sign" differs greatly from that of the last named; but it is not entirely subterranean in habit, as it may be found living in piles of brush, fallen logs, etc. Though it labors at its domicile, and collects food mainly by night, it should not be called a nocturnal animal, any more than a House Rat, though the latter is liveliest and most plaguey after dark.

Since the erection of buildings in the interior of Arizona, the Kangaroo Rat has in a measure taken up its residence about them, showing the same adaptability to semi-domestication that the House Mouse exhibits. Many used to live in our storehouses and granaries at Fort Whipple, and even brought forth their young there, in just such nooks as the common mouse would select. Parturition occurs in May or June, though more than one litter may be produced in one season. The young are for some time much darker and grayer than their parents. Although sullen, and apparently much cowed when first caught, these rats soon become familiar, and make agreeable pets. I have frequently seen them enter my tent at night, when all was still, and search about for food. They ordinarily move on all-fours, with a motion not unlike that of a rabbit when leisurely moving about. The body is alternately strongly arched and extended; the long hind feet rest on the ground to the heel, and the heavy tail trails straightly after. If frightened, this easy motion is changed to a succession of astonishingly vigorous leaps. Perhaps the most beautiful features of these animals are their eyes, which are round and full, glossy black, and softly brilliant.

Another genus of Pouched Mice (*Perognathus*) occurs in Arizona. Its species much resemble those of *Dipodomys* in general appearance. Prominent amongst them is the *P. penicillatus*, also discovered by Dr. Woodhouse on the San Francisco Mountains. It is the largest species of its genus in the United States. Two others known to occur are *P. flavus* and *P. parvus*, both of which are among the most diminutive of all our animals. Little is known of these comparatively rare animals, though it is presumed that their habits are in general similar to those of *Dipodomys*.

Family *Muridæ*, the Rats and Mice. A species of this extensive family—the *Jaculus Hudsonius*—is also called the "Kangaroo" or "Jumping" Mouse, but must not be confounded with the preceding. It belongs to the same subfamily (*Dipodinæ*) as the Jerboa (*Dipus sagitta*). It has no cheek pouches, and is otherwise conspicuously different from any member of the *Saccomyinæ*. It is of very extensive diffusion throughout North America, though I believe its actual occurrence in Arizona requires confirmation.

Exclusive of the *Dipodinæ*, the *Muridæ* are represented in North America by two subfamilies: the *Murinæ*, or true rats and mice, and the *Arvicolinæ*. The latter is composed of the Meadow-mice (*Arvicola*), the Musk-rats (*Fiber*), and the Lemmings (*Myodes*). The first subfamily is usually divided into the *Mures*, or "Old World Rats," as they are called, and really were originally, though they are now cosmopolite; and the *Sigmodontes*, or "New World Rats," embracing such forms as the Cotton Rats (*Sigmodon*), the Bush Rats (*Neotoma*), and the Field-mice (*Hesperomys*). I am not aware that any "Mures" have as yet made their way into the central and

unfrequented portions of the Territory, though the usual number of them exist at our various footholds on the Colorado River. In the interior, the indigenous species hold full sway, or at least did so two or three years ago,—the time of which I write,—though since then the Brown Rat (*Mus decumanus*), and the House Mouse (*Mus musculus*) may have migrated all over the Territory, or been transported wherever the white man has settled.

The genus *Hesperomys* is, perhaps, the best represented of the *Sigmodontes*. At least one species (*H. eremicus* Baird) is very abundant, both along the Colorado valley and the interior of the Territory. I found it very numerous at Fort Whipple, where it in a great measure seemed to abandon its primitive habits, and take up its residence as a veritable house mouse in buildings, particularly our granaries and store-rooms. It was sufficiently numerous to become quite an annoyance, sharing the plunder and comfortable home with the Kangaroo Rats. It ordinarily lives in bushes, brush-heaps, scrubby trees, etc., where it builds a somewhat bulky nest, of a globular shape, of grasses compactly matted together, and warmly lined. Another species (*H. Sonoriensis*) which I have never personally met with, occurs in the southern portions of the Territory. Mr. Clarke says that it seems to live, as circumstances may determine, either in the ground or in hollow trees. The species (or perhaps only variety of *H. leucopus*) called *H. Texensis* by Dr. Woodhouse, may also occur in South-eastern Arizona.

The genus *Reithrodon* (of which the little Harvest-mouse of the Southern States (*Reithrodon humilis*) is a typical species) is very similar to *Hesperomys*, but the upper incisors are longitudinally grooved instead of being

perfectly smooth. Those species most likely to occur are *Reithrodon montanus* Baird, of which the type is from the Rocky Mountains in latitude 39°; and *R. megalotis* in the regions contiguous to Sonora. They must either be quite rare, or of very inconspicuous habits.

The Bush Rat (*Neotoma Mexicana*) is abundant throughout the Territory, and forms no small item in the economy of the Indians. Not only the numerous tribes of the Colorado, but also the various branches of the Apaché family, make great use of them as an article of food. After the destruction of Apaché "rancherias," we always found, among other implements and utensils, numerous sticks, about as big as walking-canes, one end of which was bent in the shape of a hook, hardened in the fire, and a little sharpened. These, I was informed and have every reason to believe, were used to probe holes and poke about brush-heaps for rats, and to drag them out when discovered.

This statement may be doubted by those who know of the Bush Rat only as an arboreal species, building a compact globular nest of grasses and sticks in mezquite and other low thick trees. While this is certainly the case, there is no doubt that, under different circumstances, it may live underground, among rocks, or in brush-heaps. I have seen many heaps of rushes, sticks, and grasses, which could have been the work of no other animal, and formed either the nest itself, or the "vestibule" of a subterranean abode. I have also been informed to the same effect by several hunters and good observers. Dr. Kennerly has found it living under stones. It shows no tendency to modify its primitive habits by taking up its residence with man.

The food of these rats is entirely vegetable, and ob-

servers agree in noting their particular fondness for mezquite beans; both the long straight pods of the *Algarobia glandulosa*, and the curious spirally-twisted fruit of the "screw-mezquite" (*Strombocarpa pubescens*). As might be expected from the nature of their food, their flesh is excellent eating.

The idea of eating rats is doubtless disgusting to most persons—not Chinese nor Indian; but all such must remember that they take their notions from the House Rat, which is a dirty beast, feeding upon sewerage, garbage, and any decaying animal or excrementitious matter which may come in its way. The Bush Rat's food is as cleanly as that of a hare or squirrel, and there is no reason why its flesh should not be as good, as in truth I can assert it to be, having eaten it myself.

Arizona seems remarkably deficient in Meadow-mice (*Arvicola*). I am not aware that any species has been recorded from within its limits. At least one exists, however, as I know, having taken some fragments, too much mutilated for identification, from the stomach of a large hawk.

The Musk-rat, or Ondatra (*Fiber zibethicus*), so extensively diffused over North America, finds a place in Arizona, and is common on many of its streams. It is said that this animal and the beaver cannot live harmoniously together, the one harassing and finally dislodging the other; but I cannot vouch for the truth of the assertion.

The Indians make considerable use of Musk-rat skins for quivers, a number of them being sewn together, though a single skin of some larger animal, as a lynx, is usually preferred.—*To be concluded.*

THE AWAKENING OF THE BIRDS.

BY T. MARTIN TRIPPE.

To those who are in the custom of studying the habits of our native birds, their awakening, and early songs are very interesting. It is in the early morning that birds are in the highest spirits; then it is that they appear to the best advantage; and then it is that their songs are sweetest. When summer comes on, and the days grow hot and long, and the singing of the birds ceases nearly altogether, early in the morning, ere yet the sun has warmed the cool air, the birds sing with all their former vivacity, and seem the same merry-hearted beaux that they were in spring. The early morning has always been a favorite time of mine for studying Natural History, and especially Ornithology; and I always learn more in one hour then, than in three or four in the middle of the day.

Some birds rise much earlier than others. As a rule, those that live in the fields are much earlier risers than those dwelling in the woods; and, *per contra*, the field birds go to bed earlier than the wood birds.

The Robin is our earliest songster. While the stars still twinkle, and the first gray streaks of dawn have but just appeared, the Robin wakes from his sleep, and pours forth his matin hymn. From all sides the songs proceed, —from the orchard and garden, from the edge of the neighboring woods, and from the trees that fringe the brooks and ponds, you hear the joyous, ringing strains of this delightful songster. After singing for ten minutes or so, Robin descends from his perch, and seeks his breakfast with an appetite sharpened by the morning air; yet you hear him throughout the morning, but not so

often as in the early dusk. Then he puts forth his finest effort; and if you would fully appreciate his song, you must listen to his *matinee* which he gives in the earliest light.

While the Robin is yet singing, the two Pewees awake, and mingle their mournful notes with the Robin-concert. These notes, though so sad and plaintive, have, nevertheless, a pleasing effect; and the common Pewee especially is welcome. Long after you have ceased to hear him in the broad glare of day, or even in the quiet evening, you may listen to him in the early morning, the fresh air of which seems to have an electric effect, not only upon him, but upon all the other birds besides.

Shortly after the Robin has finished his song, or rather while he is still singing, the Bluebird is heard "saluting the morn with his soft notes." You seldom hear him during the hot summer days of June and July; but here, in the early morning, he is the same gallant and musical fellow that he was in March and April. Simultaneously with the Bluebird the Chipping Sparrow awakes, and is soon heard chanting his simple cricket-like song from the garden and lawn.

But now, as the light increases, and the clouds in the east give evidence by their crimson hues that the sun is nearing the horizon, birds of all sorts begin to awake. The sharp "*sphack*" of the Least Flycatcher comes from the orchards; the King-birds make the fields noisy with their notes, and the songs come so thick and fast, that it is next to impossible to tell which was the earliest. The Song Sparrows and the Indigo-birds sing sweetly from their accustomed haunts, while the Vesper Sparrow delivers his delightful strains from the broad open pasture-lands. This latter bird seems to take a fancy to singing

in the dusk, for, although one may hear him at all hours, still he prefers the dim morn or the quiet twilight. The Bobolink is an early riser too, and his jolly, jingling notes add much to the chorus of bird-voices that now chant so sweet a concert on every side.

The forest birds are now awake, and from the dark, distant woods come the faint bell-like notes of the Wood Thrush, our prince of songsters. The Veery, and the Rose-breasted Grosbeak join in with him, and the woods soon ring with the notes of these three birds, who are unquestionably our finest songsters. The Vireos, who have been awake some time, lend their sweet voices to swell the choir; and as the sun rises in the sky, the concert each moment grows louder and louder. The Golden-crowned Thrush begins his hurried, ecstatic song; the Wrens, Catbirds, Orioles, Warblers, and Sparrows, all add their notes to the sylvan concert; and by the time the sun has lifted himself well above the horizon, all the birds are awake and in full song.

AGENCY OF INSECTS IN FERTILIZING PLANTS.

BY W. J. BEAL.

(Concluded from page 260.)

THERE are two other peculiarities among certain plants by which a cross-fertilization is made most probable, and even very sure in some cases, notwithstanding the flowers are all perfect and of one form.

In some of these the stigmas come out and are fertilized before the anthers of the flower burst open; while in

others the anthers are in advance, and discharge their pollen before the stigmas appear. In either case the flowers act as though they were monœcious.

These peculiarities have been termed *dichogamy* by Sprengel, who made the discovery many years ago. Of the first kind, in which the stigmas are in advance of the anthers, I examined the young flowers of several species of Spiræa, just before any of the anthers had opened, and in all I found the stigmas quite plentifully covered with the yellow powder. Many stigmas were dry and withered, while some of the anthers were still full of fresh pollen. Similar observations were made upon False Solomon's Seal, several species of Potentilla, Plum, Cherry, and others. One of the best examples of this kind was pointed out by Dr. Gray, in the case of the Plantain or Ribgrass (*Plantago lanceolata* Linn.), a troublesome plant which is too rapidly finding its way into meadows and waste places.

These flowers, in arrangement, somewhat resemble a short tapering spike of Timothy or Herd's-grass. The long hairy stigmas come out first at the base of the spike, and are quite withered and dead before the stamens of the same flowers appear in sight. By the time the long thread-shaped stamens of the lowest flowers hang out their anthers, the stigmas of other flowers higher up the spike are exposed and ready to receive the fertilizing element. So new pistils continue to come forth, keeping in advance of the stamens. The long filament raises the anther so high that it is brought near the stigmas of younger flowers farther up the spike. This plant, like most of the large Grass-family, is not visited by insects, as it secretes no nectar, but each anther is hung on a mere point (versatile) and every slight motion of the air keeps it flutter-

ing. By applying a low magnifying power, the pollen was seen with its long tube thrust into the stigma before anthers had shown themselves above the calyx. While within the calyx the filaments are folded upon themselves, which accounts for their great length as soon as they come forth.

The Broad-leaved Plantain (*Plantago major* Linn.), so common about door-yards, resembles the one above mentioned as regards its mode of fertilization.

On the long spikes of flowers of the False Indigo and Lead-plant (*Amorpha fruticosa* Linn., and *A. canescens* Nuttall), the bees and wasps were seen beginning at the base on the older flowers, and so passing up, visiting those above in which the anthers were still young and enclosed by the corolla. Here, as in the Plantain, the pistils are a day or two in advance of the stamens, and the insects are a means of affecting a cross-fertilization.

The common Dandelion (*Taraxicum dens-leonis* Desfontaines) is a good example of the other kind of dichogamy, in which the anthers discharge the pollen before the stigmas are ready to receive it. This belongs to a very large family called *Compositæ*, which contains from one-eighth to one-tenth of all the flowering plants in this part of the world. Each yellow head in the Dandelion is a cluster of small flowers packed closely together, and not one large compound flower as the name implies, which was given by the early botanists. Each pistil bears two long slender stigmas surrounded by the anthers which are united by their edges, forming a tube (*syngenesious*). The stigmas are covered on the outside with small hairs, having their tips pointing upwards, like the beards on a head of barley.

Imagine a head of barley much lengthened and split in two down the middle, and you have a good representation of the stigmas of a Dandelion. When the tips of these are just above the apex of the anthers, the pollen is discharged and carried up on the hairs by the style which grows very rapidly at this time.

The stigmas are closely pressed together until clear above the anthers, when they begin to spread and roll back, exposing the inside surface which alone is sensitive to the action of the pollen. Several kinds of bees, flies, and smaller insects visit these flowers and brush the pollen off the outside of the style, and leave some on the inside surface where it can take effect. Were it intended for close, self-fertilization, as a superficial examination would seem to indicate, the style should be shorter, and the stigmas a little separated, so that pollen would meet the proper surface before the stigmas leave the surrounding anthers. Or else the surface, which is sensitive to pollen, should be on the outside instead of on the inside.

I have examined Coreopsis, Fall Dandelion (*Leontodon*), and Succory, and many more of this vast family, which showed these same peculiarities mentioned above.

In Sweet Coltsfoot (*Nardosmia*), a rare plant of this order growing north of this latitude, some of the little flowers are sterile, i. e., the imperfect pistil bears no seed, but the top of the style has a tuft of little hairs which push up the pollen from the anther-tube that it may reach the stigmas of other flowers, and so not be entirely lost.

At the suggestion of Dr. Gray I examined some half a dozen or more species of Bellflower, or Campanula. The one most carefully noticed was *Campanula rapunculoides*.

It has five anthers which stand up close together, although not joined by their edges into a tube as in the dandelion. In three other respects it resembles this plant; namely, in having the style covered with hairs or short bristles on the outside, and in having the sensitive part of the stigma on the inside. In the same way also the style nearly doubles in length after the pollen is discharged.

The pollen begins to discharge very soon, so that by the time the corolla is fairly open, the anthers wither, and are coiled up at the base of the flower. After the hairs on the style have nearly all disappeared, and the pollen which they held has been removed, or has turned brown in decay, the stigmas separate at the top, and expose the sensitive surface. For each flower to be self-fertilizing, this plan is a perfect failure.

Bees are willing agents here, as in other instances, alighting first on the stigmas of the oldest flowers, which are farthest down the stem, and then passing up to others which are younger. Besides collecting nectar at the bottom of the flower, they collect the pollen by scraping the style upon each side with their legs, and, when calling at the next flower, first strike the exposed stigmas, leaving a few little morsels as tribute for their bountiful supply.

The flowers of the Mallow Family have numerous stamens, joined into a column or tube (*monadelphous*), through which the stigmas are protruded. My observations on this family have been rather limited, but in the High Mallow (*Malva sylvestris* Linn.), the anthers all burst, and very little pollen remains about the flower, when the stigmas first come to the light, as brides too late for the marriage, for the bridegrooms have been carried away by the priests, and perhaps wedded to others.

The fact once well established, that insects are necessary to fertilize plants, brings up some other interesting inquiries in reference to the origin of animals and plants. Some would probably say that plants, which now require the agency of insects, have arrived at their present form by a long series of gradual changes, and that before the proper insects were created they were capable of self-fertilization. Others may say that the plants of this structure were created later than those capable of self-propagation, and upon which the insects could subsist for a time. Another plan can, however, be devised, as they are alike useful to each other. "As the bow unto the cord is," they may have been called into existence at the same time, the flowers to secrete nectar for the insects, and the insects to fertilize the flowers.

Were Dr. Watts again alive, and should some one tell him these facts of science, he might well exclaim, as the Queen of Sheba did to King Solomon, "Behold the half was not told me." He gave us but half the story, and that the one which teaches the least instructive lesson. It is now over two years since some one, I wish I knew his name, rung the change,—

> "How doth the little busy bee,
> Improve each shining hour,
> By carrying pollen day by day,
> To fertilize each flower."

The bees go buzzing through the air visiting flower after flower, not only to get their daily bread, but render an essential aid in perpetuating the existence of the very same plants which furnish them food.

This furnishes another pertinent illustration of the mutual dependence of the animal and vegetable kingdoms.

THE TARANTULA.

BY G. LINCECUM, M. D.

This very large hunter-spider makes its appearance in Texas some years as early as the twenty-fifth of May, generally, however, not earlier than the first days of June. They dwell in the ground in a hole, which they excavate themselves, about one inch in diameter, and six or eight inches deep, widening a little at the bottom. They make their nocturnal hunting excursions for some distance from the hole, returning to it early in the morning, and are occasionally seen walking out of evenings, and also in cloudy days. They would probably hunt their prey altogether by daylight, were it not for their dread of the great *Pompilus formosus*, or Tarantula Killer, their natural enemy. Towards sunset, about the first of June, the *Mygale Hentzii*, or Tarantula, is often seen creeping along the narrow paths in the grassy woods, or in the prairies, searching for some kind of small game,—worms, grasshoppers, small lizards, anything they can kill, upon which they leap with great violence and wonderful agility. I discovered one of their holes several years ago in my garden, and, looking into it, could see the eyes of the Tarantula glittering like coals of fire. I procured a large fat grub, and holding it near the mouth of the hole, the Tarantula instantly rushed out, and seized the grub with such violence as to startle me. I fed it daily for two weeks, and it consumed two large grubs each day. It became quite tame and much more decent in taking its meals from my hands.

On going into the garden one evening, I met our large red-winged Pompilus—it was also one of our pets, parad-

ing about the house and yard—dragging my murdered Tarantula, which was as limber as a rag, out through the gate. She dragged the paralyzed victim to the dwelling-house, distant about fifty yards, and entombed it in her great cemetery under the floor, where she had already deposited many of its kindred.

I have been observing this spider as closely, considering its nocturnal habits, as I could during the last twenty years. I have seen no nests, no webs, no eggs, nothing but a roughly-made hole seven or eight inches deep, carried down not quite perpendicularly, and widened a little at the bottom. I have examined many of these holes, and, except an occasional dead grasshopper, saw nothing in them that suggested the idea of a nest. These holes seem to be fortifications only, to protect them while they sleep from the incursions of their diurnal enemies.

I have seen their young many times, always sticking among their stiff hairs, and clinging to their legs and body; but where these young ones come from I am not prepared to explain, nor can I with my present experience say, whether the Mygale Hentzii is viviparous or oviparous. Its habit is to carry its young on its back until they are large enough to capture small insects for themselves, when it turns them off in some good hunting-ground in such numbers that they would soon, if they could all come to maturity, monopolize the entire privileges of spiders on this little green globe.

Some of the ground spiders carry their eggs in a sack attached to the tip of their abdomen. One species makes nests with a trap-door to them. They are rare in this country. I have never seen any such contrivances about the hole of the Tarantula, nor have I ever seen it carrying an egg-sack. It may be possible that they keep such a

sack at the bottom of their hole, and, when the young hatch out, take them on their back and carry them about, as I have often seen them. I have, however, never discovered any such egg-sack, though I dug out many of their holes. It may be that I did not dig them up at the proper time to find their eggs. They are too filthy when confined, or I would send you a live one.

Two or three species of Mygale carry a sack well filled with eggs, attached to the tip of their abdomen; and when the young ones hatch out, they take them on their backs and carry them like the Mygale Hentzii. There is one species of the family that constructs an exceedingly curious gossamer nest in a hole in the ground. It first digs the hole about six inches deep, and then lines it thickly to the bottom with a very fine white web, finishing it with a cunningly wrought and very neatly fitting trap-door, having hinges and a string to fasten it on the inside. This type of spiders is very rare in Middle Texas.

THE LAND SNAILS OF NEW ENGLAND.

BY EDWARD S. MORSE.

(Continued from page 315.)

WE continue our descriptions of New England Land Snails, with a species very common in certain portions of the West and South, though of very rare occurrence in New England.

HELIX SUPPRESSA *Say*. (Fig. 25.) Shell thin and pellucid; yellowish horn-color, polished; spire flat. Whorls six, closely revolving; suture distinct; lip simple, thickened within. Base of shell rather convex; near the aperture

Fig 25.

opaque, and yellowish white. Umbilicus absent, or hardly apparent in adult specimens. Within the aperture on the outer lip are one or two long thin teeth. Diameter of shell about one-fourth of an inch. Animal bluish black, upper tentacles long and delicate. A minute slit on the extremity of the body exudes mucus freely when the snail is crawling.

This species can at once be distinguished from all the others to be described, by the peculiar teeth in the aperture. Common in the Middle States and Ohio. It has been found in the extreme western part of Connecticut. Mr. W. G. Binney states that he has generally found them in open fields at the roots of grass, and not under decaying stumps and rotten bark.

Helix concava *Say*. (Figs. 26, 27.) Shell depressed, whitish horn-color. Whorls five, flattened above, rounded below; suture very distinct. Umbilicus wide and deep, revealing all the volutions to the apex. Aperture rounded, slightly flattened above. Usual diameter one-half an inch. Animal grayish, disk dusty white, with reddish discolorations. Found in nearly every State in the Union; quite rare in New England.

Figs. 26, 27.

This species is peculiar in its habits. It lives in the dark woods, and is a regular cannibal in its propensities. Its body is long, slender, and worm-like. Its jaw has a sharp projecting point to cut and tear its prey, and the teeth on the tongue are unusually long and pointed, and well adapted to subserve its rapacity. It lives on the flesh of other snails. With its long and slender body, it insinuates its head into the aperture of the shell, the inmate of which it is about to devour. The victim with-

draws far within the shell, but in vain. Its enemy slowly approaches, and the hapless victim having no barrier to interpose, nor any line of retreat open, is actually devoured bit by bit. We remember collecting a lot of rare snails in the backwoods of Maine. Wishing to study them, they were unsuspectingly placed in a box of moist earth containing a few specimens of our cannibal snail. Imagine our astonishment and indignation on examining the box a few days after, and finding our special rarities completely destroyed, only a few empty shells remaining as tokens of the cannibal feast. We could almost see the murderers smacking their slimy chops and begging for more.

Other species are known which possess this desire for animal food, and the collector in France oftentimes secures a goodly number of specimens by placing a piece of fresh meat in the woods, the odor of the meat attracting certain species; for snails apparently possess, in a considerable degree, the faculty of smell, and will, with nice discrimination, select from a parcel of leaves those most succulent and agreeable.

HELIX INDENTATA *Say.* (Fig. 28.) Shell flattened, thin, pellucid, highly polished, whitish, sometimes pinkish. Whorls four, rapidly enlarging, with regular impressed lines radiating from the suture, reaching nearly to the base of the shell. Lip simple, extending to the centre of the shell at its base. Umbilicus absent, though its region is indented. Diameter of shell nearly one-fifth of an inch. Animal bluish black. Inhabits deep woods in the Northern, Middle, and Western States. This beautiful species is not common. It can readily be distinguished from allied species by its closed umbilicus.

Fig. 28.

We refer our readers to the early papers on this subject in this Magazine, where an explanation of the terms used in these descriptions may be found.

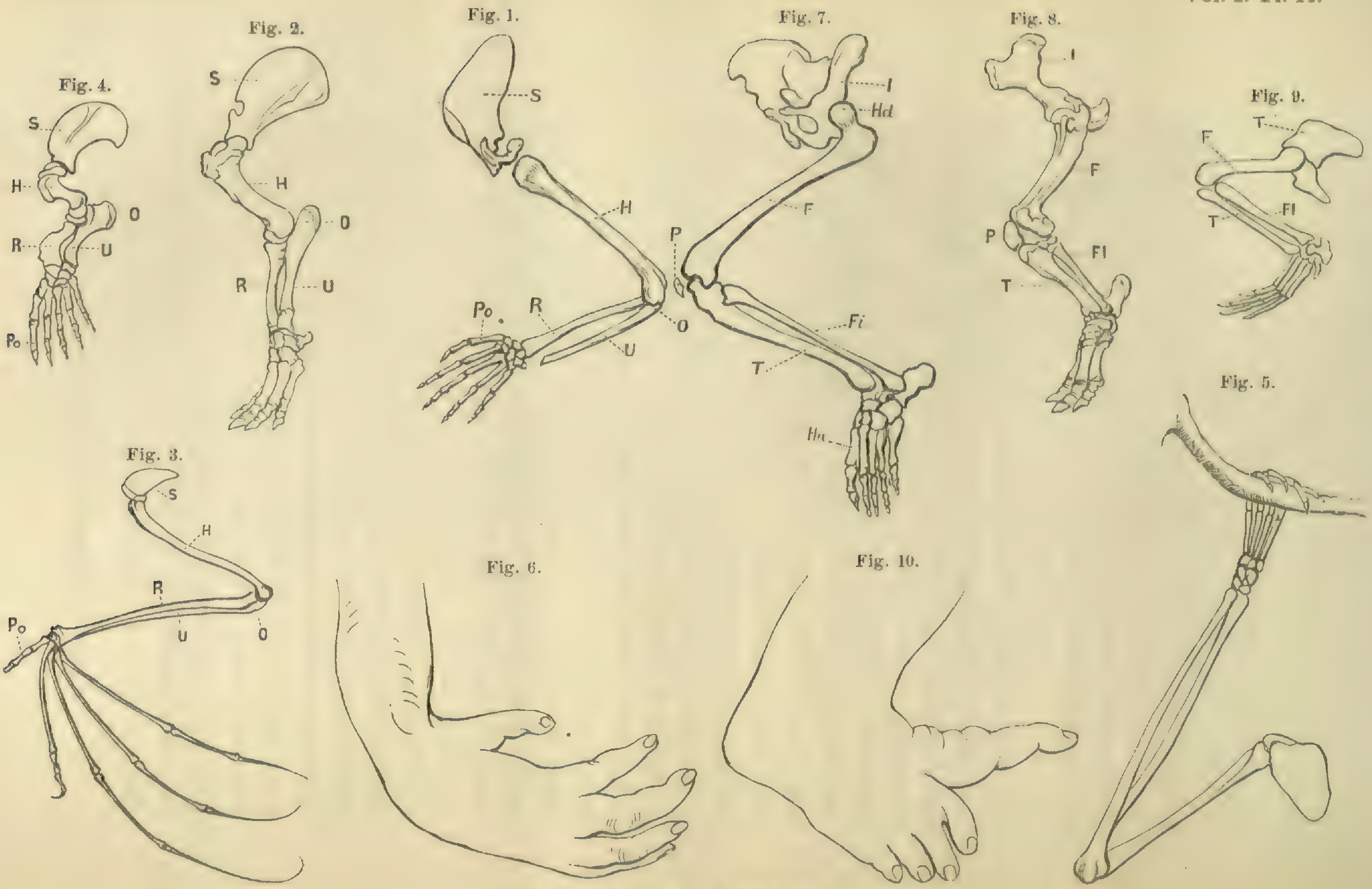
The brevity of these papers is owing to their being intended principally for those who are making, or wish to make collections in this entertaining branch of natural history, and are offered as guides to them. Hopes are entertained that others may be led to form collections, from the brief hints thrown out respecting the hiding-places of these almost obscure animals. Many who spend their leisure time in solving illustrated riddles, and derive, as the result of their labor, simply an answer, would find that the expenditure of half the brain-work, if applied to the identification of the fruits of a day's ramble in the woods, would furnish not only a healthier intellectual enjoyment, but, with proper training, lead to an endless pleasure in the contemplation of the boundless wealth of creation.

St. Augustine has truthfully written that "every species of animal has beauties peculiar to itself. The more man considers them, the more they engage him to adore the Author of Nature, who has made everything in wisdom, who has subjected everything to His power, and whose goodness governs the whole."

THE HAND AS AN UNRULY MEMBER.

BY BURT G. WILDER, M. D.

Natural History is not now the simple thing it was a century ago. Leaving out of view the two great departments of Botany and Mineralogy, it then consisted of a



WILDER ON THE HAND.

limited and superficial acquaintance with the habits and external appearance of the few known animals; how few these were, as compared with those we now know, may be seen from this, that, in 1748, Linnæus enumerated *two hundred and eighty* different kinds of fish; at the present time, the Museum of Comparative Zoölogy at Cambridge, Mass., contains over *nine thousand* species of that class, about *twenty-two hundred* of which were collected in the late Thayer Expedition to Brazil.

So impossible is it for any one person to gain a thorough knowledge of all animals, that we find men devoting years, their lives almost, to the study of a single species;* while it is daily becoming more and more apparent, that in order to advance or even to keep up in modern science, each must devote himself principally to a few branches of Natural History.

To show how far this division of labor has already extended, take the single department of Comparative Anatomy, which embraces the following lines of study: 1. The anatomy of a single species considered by itself; as Anthropotomy, or human anatomy; Hippotomy, the anatomy of the horse, etc. When this kind of study is extended to the microscopic investigation of the structure of *tissues*, it is called Histology. 2. One or more species may be traced in their development and growth from their beginning as an egg to the adult condition, —this is Embryology. 3. We may enlarge our conception of the plan of creation, by comparing with the animals which now live the fossil remains of those which

*For instance, the "Anatomie descriptive et comparative du Chat," by Straus-Durckheim, 1845, comprising two quarto volumes of text and a large folio atlas of plates, yet treating of only the bones, the ligaments, and the muscles. Also, the "Traité de la Chenille qui ronge le Bois de Saule" (larva of the goat-moth, or Cossus ligniperda), by Pierre Lyonnet, 1760; a quarto volume of 615 pages and eighteen plates.

existed in past ages, this constituting the science of Palæontology. 4. Then comes Physiological Anatomy, which treats of organs in reference to their *functions;* and, lastly, there is what is called Homology, in which parts and organs are considered, not according to their *size*, or *shape*, or the specific functions which they perform, since these vary greatly in different species, but according to their *essential structure* and their *connections with other parts;* these last are called *morphological* characters, and they alone are sufficiently constant to serve as the basis of zoölogical classification. This branch of anatomy is generally followed with a view of determining and comparing corresponding or homologous organs in *different animals*, but the same methods may be employed in another way, which has been in existence for hardly a century, and for which no name has yet been fully accepted; it consists in the *determination and comparison of corresponding parts in different regions of the same individual.*

To illustrate the distinction between these two kinds of Homology, by reference to familiar objects, the former would compare the foremast of one ship with that of another, and note their difference in the size and proportion of the various pieces; while the latter would compare the foremast with the mainmast of the same ship, pointing out their resemblance, and the differences in the length of the various pieces.

It is to this latter kind of anatomy that I propose to call attention, and have chosen for a subject an organ which, though small, is most comprehensive, gathering within its grasp far more than can be illustrated in this short article,—the Hand.

It is a time-honored theme, and he stands in great dan-

ger of repetition who takes for his subject a part of our corporeal frame, concerning which there has been written by men of science, preached by divines, and even sung by poets, more than of any other organ, excepting, perhaps, the eye. He would indeed be most presuming who should, without the reputation and consciousness of most profound knowledge, undertake to more than express his concurrence in what has been already said concerning the beauty of form, the complexity of structure, the marvellous skill, and the wonderful diversity of function which characterize the human hand.

There is, however, a view of the subject to which little attention has been paid by those who have treated it, but a correct idea of which is really essential to the fullest appreciation of the wonders so eloquently set forth by Sir Charles Bell,* and by anatomists generally,—a view in which the human hand, while furnishing to the student of *final causes*, to the *teleologist*, his most perfect illustration of the adaptation of means to desired ends, becomes to the *morphologist*, to the student of *unity of type* under diversity of form and function, a fruitful source of anxiety, and even, as will be seen, of serious error.

So widely spread and so deeply rooted is this error, and so almost wholly is it due to the peculiar structure and endowments of the hand, that we are justified in drawing a comparison between it and that other organ whereof the Apostle wrote,—"Even so the tongue is a little member. . . . . It is an unruly evil, full of deadly poison."

Now it is evident that by *tongue* in this connection is by no means indicated the mere anatomical organ which all vertebrates carry in the floor of the mouth, composed of certain muscles, supported by certain bones, and sup-

* In his admirable Bridgewater Treatise on the Hand.

plied with nerves of motion and of sensation. We are indeed right in applying the *name* tongue to the fleshy pad in the mouth of the fish, to the prehensile fly-catcher of the chameleon, to the barbed harpoon of the woodpecker, and the glutinous snare of the ant-eater, thus recognizing in a cold, scientific way, their anatomical or *morphological* identity with the corresponding organ in the human body. But this last alone is used as a synonym for language; it alone is the facile medium of ideas, as well as of sensations; it alone has entered the service of an immortal soul, and is characteristic of man.

So with the hand. We recognize the same bones which form our upper limb (Fig. 1) in the foreleg of the quadruped (Fig. 2), in the wing of the bird and of the bat (Fig. 3), in the flipper of the seal (Fig. 4), and still more strikingly in the so-called *arm* of the ape (Fig. 5); and though the forefoot of the bear is merely a *paw* when supporting his ungainly bulk upon the earth, yet when it is flourished in the air as he sits erect upon his haunches, we are glad to escape the blow of what is then admitted to be a tolerable imitation of a hand.* And yet it is not really such; for if the presence of a thumb, capable of being opposed to the tips of any or all the fingers, is the distinguishing feature of a hand, we shall look for it in vain throughout the whole animal kingdom below man; for even in the gorilla the first digit, though strong, is short, and reaches only to the knuckle of the forefinger (Fig. 6), while in many of the lower monkies it is altogether wanting, and when present in quadrupeds is so intimately connected with the other digits as to have no independent motion.

We may assume, then, that the tongue and the hand,

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*As in Pliny, 8. 36. 54.

not in the anatomical or morphological, but in the functional or teleological sense, are the really characteristic organs of man, corresponding with his peculiar endowments of rationality in thought, and freedom in action; and so it is not a little significant that to these same organs alone, which, being the most capable of good, are, by perversion, the most potent for evil, can the term *unruly* properly be applied. For they are, either singly or together, the chief ground of discussion as to "man's place in nature," showing him to be a most unruly member of the animal kingdom; they are the agents of the individual in becoming an unruly member of society, and they are, or represent, those regions of the body whose relations to other parts have ever caused the greatest trouble among the students of Philosophical Anatomy.*

Leaving to the zoölogist, the moralist, and the historian, the consideration of their respective claims to the "bad preëminence," and confining our attention to one of them, it may also be said that not only is the hand, as a whole, the main element in the discussion to which I have referred, but that the very heat and fierceness of the strife has always centred upon the most characteristic part of this characteristic organ of humanity,—the thumb.

But it is asked, What is this terrible discussion all about, and what is the matter with our hands, and especially with our thumbs?

In brief, a careful study of the anterior limbs of vertebrate animals having shown that all are built upon one general plan, but varied in form and proportion to suit

*See the various and diverse theories of the skull, especially the antagonistic ones of Owen, "On the Archetype and Homologies of the Vertebrate Skeleton;" Report of the British Association for 1846; and Huxley, "Elements of Comparative Anatomy."

the special needs of man, of the beast, the bird, and the reptile, and a like survey of the posterior limbs having shown the same to be the case with them (Figs. 7, 8, 9), so that they all present different degrees of homology or morphological relationship, our anatomical pioneers have conceived that a *similar correspondence prevails between the anterior and posterior limbs themselves;* so that not only is the shoulder, at one end of the body, merely a repetition of the pelvis at the other, but the arm as far as the elbow is seen in the thigh with the knee, the forearm in the leg, the wrist in the ankle-joint, and the hand, alas, in the foot,—"Pes altera manus."*

But here, *in extremitatum extremis*, humanity rebels. Science has gone far enough in proving that, for purposes of rational comparison and anatomical inquiry, man must assume a horizontal position on all-fours like a beast, so that his arms and legs become mere "anterior and posterior extremities;" after which degradation he can indeed arise and resume the attitude proper to the lord of creation. But to his upper and nobler parts this last comparison is most odious. They entreat us with clasped hands, they threaten us with clenched fist; they would flee from the threatened contamination; they would sit in sullen scorn at the degrading fellowship: but neither active or passive resistance is possible without the aid of the despised member, and so by slow degrees it is granted that the *ilium* (Fig. 7 I) does look very like a *scapula* (Fig. 1 S); that the *femur*, or thigh-bone (F), bears a wonderful resemblance to the *humerus*, or bone of the arm (H); that the knee-pan (P) is quite as exposed a part as the elbow; and that, perhaps, the taper forearm is only a

* These are the closing words of the first treatise upon this subject,—a paper by Felix Vicq d'Aryr. Œuvres recuilles par Moreau, 1805, Vol. IV. p. 37. Mems. de la Academie Royale des Sciences, 1794.

better view of the "calf" of the leg; but as for admitting between the hand, —

> "Her hand,
> In whose comparison all white are ink,
> Writing their own reproach; to whose soft seizure
> The cygnet's down is harsh, and spirit of sense
> Hard as the palm of ploughman," —

any equality whatever with the foot, which is so ugly that here, as well as at the antipodes, the bootmaker's skill and our own endurance are taxed to their utmost to force it into proper shape; this is too much, and not to be allowed.

And here it may be added that the foot presents, in this respect, a contrast with the hand, not only physical, but, as it were, metaphysical; for it is plain, honest, and inoffensive, and, though much abused, shows no disposition to become an unruly member. In ancient times, indeed, warriors did cut off the great toes as well as the thumbs of their captives, but the toes are the only part of the body thrown into disuse by modern civilization, while the fingers are cherished and exalted to the highest degree. The foot is the hand's poor relation, and, though not ambitious to share its high offices which nevertheless it has often shown itself capable of discharging to an astonishing degree, yet claims, and justly too, its right in the family name.

But no; the haughty hand heeds not the humble foot, and at length, with the single warning, that, in case any remote cousinship is proved between them, the thumb has sworn to admit into his society only the great toe, which, like himself, has but two joints, and in the ape (Fig. 10) does bear him some slight resemblance, distressed humanity resigns the whole affair to the comparative anatomist. And now, after a hundred years of controversy,

comparative anatomy presents her report, admitting with shame, that, in spite of their meagre number, scarce two of her votaries can agree upon any one point, and that only two or three have ventured to disregard the above-mentioned threat on the part of the thumb. It will be seen, however, that while thus heeding the wish of that powerful constituent of the more aristocratic member, there has been a general though tacit recognition of the good conduct and sobriety displayed by its humbler representative, so that, with one notable exception,* the lower limb has been left unmolested, while the more pretentious arm has suffered all the pangs of dislocation, misplacement, twisting, and compound fracture, as the consequence of the thumb's stubborn pride.

A brief sketch of such portions of the controversy as best illustrate the unruly character of the hand, it is my purpose to lay before the reader in succeeding articles.

EXPLANATION OF FIGURES ON PLATE 11.

In all the figures, S denotes the *Scapula*, or shoulder-blade; I. the shin or chief bone of the pelvis; H, the *Humerus*, or bone of the upper arm; F, the *Femur*, or thigh bone, the corresponding bone of the leg; O, the *Olecranon process*, which forms the tip of the elbow; P, the *Patella*, or knee-pan; U, the *Ulna*, or inner bone of the forearm; T, the *Tibia*, or inner bone of the leg; R, the *Radius*, or outer bone of the forearm, which supports the thumb when there is one; and Fi, the *Fibula*, or outer bone of the leg. The hand and foot are easily distinguished in all the limbs; but Po, indicates the *Pollex*, or thumb, and Ha, the *Hallex*, or great toe.

Fig. 1. Arm of Man, as it is when we get down upon "all-fours."

Fig. 2. Foreleg of Tapir; it has no thumb, and is, of course, much thicker and stronger, but otherwise corresponds quite closely with the human arm.

Fig. 3. Wing of the Bat. The scapula is very small, but the other

*In which both thumb and great toe are considered too large, and are split in twain, so as to correspond, the one to the two lesser toes, and the other to the two lesser fingers.

bones, especially the fingers, are very long and slender, to support the thin web.

Fig. 4. Foreleg or "flipper" of Seal; the bones are in great contrast with the last, but the same parts are represented.

Fig. 5. Arm of a Monkey, which has no thumb.

Fig. 6. Hand of the Gorilla; the thumb smaller than in man.

Fig. 7. Leg of Man.

Fig. 8. Hind leg of Tapir.

Fig. 9. Hind leg of Alligator.

In these three figures it is easy to trace the corresponding bones, as in Figs. 1, 2, 3, and 4.

Fig. 10. Foot of Gorilla; the great toe very large, and standing off from the others like a thumb.

By comparing Figs. 1, 2, and 4, with Figs. 7, 8, and 9, one can hardly fail to see that not only are there corresponding segments in the fore and hind limb, but also that, except in case of the hand and foot, these corresponding segments point in *opposite directions*, so that the three figures on one side are, to those on the other, as three right arms to three left arms; they are *symmetrical*.

THE CLOTHES-MOTH.

BY A. S. PACKARD, JR., M. D.

For over a fortnight we once enjoyed the company of the caterpillar of a common Clothes-moth. It is a little pale, delicate worm (Fig. 1), about the size of a darning needle, not half an inch long, with a pale horn-colored head, the ring next the head being of the same color, and has sixteen feet, the first six of them well developed and constantly in use to draw the slender body in and out of its case. Its head is armed with a formidable pair of jaws, with which, like a scythe, it mows its way through thick and thin.

Fig. 3.

Fig. 2.

Fig. 1.

But the case is the most remarkable feature in the history of this caterpillar. Hardly has the helpless, tiny worm broken the egg, previously laid in some old garment of fur, or wool, or perhaps in the hair-cloth of a sofa, when it proceeds to make a shelter by cutting the woolly fibres or soft hairs up into bits, which it places at each end in successive layers, and, joining them together by silken threads, constructs a cylindrical tube (Fig. 2) of thick, warm felt, lined within with the finest silk the tiny worm can spin. The case is hardly round, but flattened slightly in the middle, and contracted a little just before each end, both of which are always kept open. The case before us is of a stone-gray color, with a black stripe along the middle, and with rings of the same color round each opening. Had the caterpillar fed on blue or yellow cloth, the case would, of course, have been of those colors. Other cases, made by larvæ which had been eating "cotton wool," were quite irregular in form, and covered loosely with bits of cotton thread, which the little tailor had not trimmed off.

Days go by. A vigorous course of dieting on its feast of wool has given stature to our hero. His case has grown uncomfortably small. Shall he leave it and make another?—No housewife is more prudent and saving. Out come those scissor-jaws, and, lo! a fearful rent along each side of one end of the case. Two wedge-shaped patches mend the breach,—caterpillar retires for a moment; reappears at the other end; scissors once more pulled out; two rents to be filled up by two more patches or gores, and our caterpillar once more breathes freer, laughs and grows fat upon horse hair and lamb's wool. In this way he enlarges his case till he stops growing.

Our caterpillar seeming to be full-grown, and hence out

of employment, we cut the end of his case half off. Two or three days after, he had mended it from the inside, drawing the two edges together by silken threads, and, though he had not touched the outside, yet so neatly were the two parts joined together that we had to search for some time, with a lens, to find the scar.

To keep our friend busy during the cold, cheerless weather, for it was in mid-winter, we next cut a third of the case off entirely. Nothing daunted, the little fellow bustled about, drew in a mass of the woolly fibres, filling up the whole mouth of his den, and began to build on afresh, and from the inside, so that the new-made portion was smaller than the rest of the case. The creature worked very slowly, and the addition was left in a rough, unfinished state.

We could easily spare these voracious little worms hairs enough to serve as food, and to afford material for the construction of their paltry cases; but that restless spirit that ever urges on all beings endowed with life and the power of motion, never forsakes the young Clothes-moth for a moment. He will not be forced to drag his heavy case over rough hairs and furzy wool, hence he cuts his way through with those keen jaws. Thus, the more he travels, the more mischief he does.

After taking his fill of this sort of life he changes to a pupa (Fig. 3), and soon appears as one of those delicate, tiny, but richly variegated moths that fly in such numbers from early in the spring until the fall.

Very many do not recognize these moths in their perfect stage, so small are they, and vent their wrath on those great millers that fly around lamps in warm summer evenings. It need scarcely be said that these large millers are utterly guiltless of any attempts upon our

wardrobes, they expend their attacks in a more open form on our gardens and orchards.

We will give a more careful description of the Clothes-moth which was found in its different stages June 12th in a mass of cotton-wool. The larva is white, with a tolerably plump body, which tapers slightly towards the tail, while the head is much of the color of gum-copal. The rings of the body are thickened above, especially on the thoracic ones, by two transverse thickened folds. It is one-fifth of an inch long.

The body of the chrysalis, or pupa, is considerably curved, with the head smooth and rounded. The long antennæ, together with the hind legs, which are folded along the breast, reach to the tip of the hind body, on the upper surface of each ring of which is a short transverse row of minute spines, which aid the chrysalis in moving towards the mouth of its case, just before the moth appears. At first the chrysalis is whitish, but just before the exclusion of the moth becomes of the color of varnish.

When about to cast its pupa-skin, the skin splits open on the back, and the perfect insect glides out. The act is so quickly over with, that the observer has to look sharp to observe the different steps in the operation.

Our common Clothes-moth, *Tinea flavifrontella* (Fig. 4), is of an uniform light-buff color, with a silky iridescent lustre, the hind wings and abdomen being a little paler. The head is thickly tufted with hairs and is a little tawny, and the upper side of the densely hirsute feelers (*palpi*) is dusky.

Fig. 4.

The wings are long and narrow, with the most beautiful and delicate long silken fringe, which increases in length towards the base of the wing.

They begin to fly in May, and last all through the sea-

son, fluttering with a noiseless, stealthy flight in our apartments, and laying their eggs in our woollens.

There are several allied species which have much the same habits, except that they do not all construct cases, but eat carpets, clothing, articles of food, grain, etc., and objects of natural history.

Successive broods of the Clothes-moth appear through the summer. In the autumn they cease eating, retire within their cases, and early in spring assume the chrysalis state.

Careful housewives are not much afflicted with these pests. The slovenly and thriftless are overrun with them. Early in June woollens and furs should be carefully dusted, shaken, and beaten. Dr. T. W. Harris states that "powdered black pepper, strewed under the edge of carpets, is said to repel moths. Sheets of paper sprinkled with spirits of turpentine, camphor in coarse powder, leaves of tobacco, or shavings of Russia leather, should be placed among the clothes when they are laid aside for the summer; and furs and other small articles can be kept by being sewed in bags with bits of camphor wood, red cedar, or of Spanish cedar; while the cloth lining of carriages can be secured forever from the attacks of moths by being washed or sponged on both sides with a solution of the corrosive sublimate of mercury in alcohol, made just strong enough not to leave a white stain on a black feather." The moths can be most readily killed by pouring benzine among them, though its use must be much restricted from the disagreeable odor which remains. The recent experiments made with *Carbolic acid*, however, convinces us that this will soon take the place of all other substances as a preventive and destroyer of noxious insects.

REVIEWS.

THE DEVELOPMENT OF CHLOEÖN (*Ephemera*) DIMIDIATUM. By *Sir John Lubbock.* Parts I. II. From the Transactions of the Linnæan Society, London. Vol. XXV. 4to, 1866.

One of the most interesting discoveries in entomology is the fact that the May-fly, or Shad-fly, during its development from the time of leaving the egg up to maturity, moults its skin nineteen times before leaving the water, and once afterwards on arriving at the winged state.

All the books teach that there are three distinct states of the insect's life after hatching from the egg, namely, the larva, pupa, and imago; but there are many species belonging to different suborders of the six-footed insects, in which these stages graduate almost insensibly into each other. The terms larva and pupa are but relative, and not fixed and absolute. In the beetle or butterfly, the grub or caterpillar certainly seems very distinct from the chrysalis. But we have in the collection of the Essex Institute a series illustrating the transformations of the caterpillar into the pupa or chrysalis, which show several successive changes of form most remarkable and interesting to the student. There is also a gradual change of form from the pupa to the imago or perfect state, which most observers have not noticed.

The writer has shown* that the Humble-bee, before reaching the winged state, moults at least ten times, and probably a greater number. The bee-state is reached by a very gradual change of form. The newly hatched larva differs but slightly in appearance from the mature embryo just before hatching. The worm-like larva merges gradually into the pupa. Scarcely does the larva stop eating and gain its full size, when, on removing the loosening skin, the tegument of the half-formed pupa can be detected beneath, with the rudiments of the mouth-parts, antennæ, and wings, together with the ovipositor, which have begun to assume the shape of the same parts in the mature bee. They are, however, rudely shaped and but partially formed. So also the pupa merges into the bee state by insensible gradations, so that it is almost impossible to say absolutely which is pupa and which imago, from the inspection of specimens before us. Thus metamorphosis is but a growth and evolution of parts, intensified, so to speak, at certain intervals to adapt it to certain modes or conditions of life. In those

*Observations on the Development and Position of the Hymenoptera, with notes on the Morphology of Insects. By A. S. Packard, jr. From the Proceedings of the Boston Society of Natural History. 1867, 8vo.

insects which are active in the preparatory stages, and have the same habits in maturity as in the larva and pupa stage, such as the grasshopper and its allies, the changes are slow, and the metamorphosis slightly marked. In the butterfly and bee, however, whose life is so distinct in the perfect state, from the caterpillar or grub, the changes are rapid, though gradual, and strongly marked. They are not perhaps due so much to immediate physical agencies, as to the plan of life originally marked out for the insect by the creative mind.

In the present state of science we would prefer to think that structure is *correlated* to the mode of life, rather than that it is dependent on physical agencies. We feel scarcely prepared to believe with our author that the "actual form" of the caterpillar "is mainly due to the influence of the conditions in which it lives."*

We must look deeper than the agency of physical causes in the production of the various forms of life. In endeavoring to solve the problem of life and its manifestations, man may advance in knowledge without actually grasping the truth.

The theories now in vogue, suggested by Lamarck or Darwin, or as modified by other naturalists, though so stimulating to scientific thought, are yet not satisfactory, and do not go to the bottom of the matter. We must still wait patiently, and meanwhile observe, experiment, and reflect, and thus continue to question nature until she yields a willing reply.

We extract the following interesting remarks on the metamorphoses of insects, with the author's general conclusions: —

The larvæ of insects are generally regarded as being nothing more than immature states, as stages in the development of the egg into the imago; and this might more especially appear to be the case with those insects in which the larvæ offer a general resemblance in form and structure (excepting of course so far as relates to the wings) to the perfect insects. Nevertheless, we see that this would be a very incomplete view of the case. The larva and pupa undergo changes which have no relation to the form which they will ultimately assume. With a general tendency, as regards size and the production of wings, to this goal, there are combined other changes bearing reference only to their existing wants and condition.

Nor is there in this, I think, anything which need surprise us. External circumstances act on the insect in its preparatory states as well as in its perfect condition. Those who believe that animals are susceptible of great, though gradual, change through the influence of external conditions, whether acting, as Mr. Darwin has suggested, through natural selection, or in any other manner, will see no reason why these changes should be confined to the mature animal. And it is evident that creatures which, like the majority of insects, live during different periods of their existence in very different circumstances, may undergo considerable changes in their larval organization, in consequence of forces acting on their larval condition, not, indeed, without affecting, but certainly without affecting, to any corresponding extent, their ultimate form.

We may now pass to the second part of the subject, — that is to say, the apparently sud-

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* "The caterpillar owes its difference from the butterfly to the early stage at which it leaves the egg; but its actual form is mainly due to the influence of the condition in which it lives." Part II. p. 112.

den and abrupt nature of the changes which insects undergo. I say "apparently," because the changes in the internal organs, though rapid, are in reality gradual; and even as regards the external form, though the metamorphosis may take only a few minutes, this is but the change of outer skin — the drawing away, as it were, of the curtain; and the new form which then appears has been in preparation for days or, perhaps, weeks before.

Swammerdam, indeed, supposed (and his view was adopted by Kirby and Spence) that the larva contained within itself "the germ of the future butterfly, enclosed in what will be the case of the pupa, which is itself included in the three or more skins, one over the other, that will successively cover the larva." This is entirely a mistake; but it *is* true that, if you examine a larva shortly before it becomes a pupa, you will find that the skin is loose, and that within it the future pupa may be traced. In the same manner, if you examine a pupa which is about to disclose the butterfly, you will find the future insect, soft indeed and imperfect, but still easily recognizable, lying more or less loosely within the pupa-skin. More than one such inner skin, however, is never present.

One fundamental difference between an insect and a vertebrate animal is, that whereas in the latter, as for instance in ourselves, the muscles are attached to an internal bony skeleton, in insects no such skeleton exists. They have no bones, and their muscles are attached to the skin. Hence the necessity for the hard and horny dermal investment of insects, so different from the softness and suppleness of our own skin.

Moreover the result is, that without a change of skin a change of form is impossible. The chitine, or horny substance, forming the outside of an insect, is formed by a layer of cells lying beneath it, and, once formed, cannot be altered. From this it follows, that every change of form is necessarily accompanied by a change of skin.

In some cases, as for instance in *Chloeon*, each change of skin is accompanied by a small change of form, and thus the perfect insect is more or less gradually evolved. In others, as for instance in Caterpillars, several changes of skin take place without any alteration of form, and the change, instead of being spread over many, is confined to the last two moults.

Very little consideration will afford us an explanation of this difference. The mouth of the Caterpillar is provided with a pair of strong jaws, fitted to eat leaves; and the digestive organs are adapted for this kind of food.

On the contrary, the mouth of the butterfly is suctorial; it has a long proboscis, beautifully adapted to suck the nectar from flowers, but which would be quite useless, and, indeed, only an embarrassment to the larva. The digestive organs also are adapted for the assimilation, not of leaves, but of honey. Now it is evident that if the mouth-parts of the larva were gradually metamorphosed into those of the perfect insect, through a number of small changes, the insect would in the mean time be unable to feed, and liable to perish of starvation in the midst of plenty.

On the contrary, in the Orthoptera, and, as a general rule, among those insects in which the changes are gradual, the mouth of the so-called larva resembles that of the perfect insect, and the principal difference is in the presence of wings.

Similar considerations throw much light on the nature of the chrysalis or pupa state — that remarkable period of death-like quiescence which is one of the most striking characteristics of insect-metamorphosis. The comparative quiescence of the pupa is mainly owing to the rapidity of the changes going on in it.

In the chrysalis of a butterfly, for instance, not only, as has been already mentioned, are the mouth and digestive organs undergoing change, but the same is the case with the muscles. The powerful ones which move the wings are in process of formation; and even if they were in a condition favourable to motion, still the nervous system, by which the movements are set on foot and regulated, is also in a state of such rapid change that it could scarcely act.

The conclusions, then, which I think we may draw from the preceding and other considerations, are: —

1st. That the occurrence of metamorphoses arises from the immaturity of the condition in which some animals quit the egg.

2nd. That the form of the larva in insects, whenever it departs from the original vermiform type, depends in great measure on the conditions in which it lives. The external

forces acting upon it are different from those which affect the mature form; and thus changes are produced in the young which have reference to its immediate wants, rather than to its final form.

3rd. That metamorphoses may therefore be divided into two kinds, developmental and adaptational.

4th. The apparent abruptness of the changes which insects undergo arises in great measure from the hardness of their skin, which permits no gradual alteration of form, and which is itself necessary in order to afford sufficient support to the muscles.

5th. The immobility of the pupa or chrysalis depends on the rapidity of the changes going on in it.

6th. Although the majority of insects go through three well-marked stages after leaving the egg, still a large number arrive at maturity through a somewhat indefinite number of slight changes.

7th. When the external organs arrive at this final form before the organs of reproduction are matured, these changes are known as metamorphoses; when, on the contrary, the organs of reproduction are functionally perfect before the external organs, or when the creature has the power of budding, then the phenomenon is known as alternation of generations.

Insects present every gradation, from simple growth to alternation of generations.

8th. Thus, then, it appears probable that this remarkable phenomenon may have arisen from the simple circumstance that certain animals leave the egg at a very early stage of development, and that the external forces acting on the young are different from those which affect the mature form.

9th. The dimorphism thus produced differs in many important respects from the dimorphism of the mature form which we find, for instance, in ants and bees; it would therefore be convenient to distinguish it by a different name; and I have ventured to suggest the terms Dieidism and Polyeidism.

The same considerations explain the remarkable fact that in alternation of generations the reproduction is agamic in the one form. This is because impregnation requires the perfection both of external and internal organs; and if the phenomenon arises, as has just been suggested, from the fact that the internal organs arrive at maturity before the external ones, impregnation cannot take place, and reproduction will only result in those species which have the power of agamic multiplication.

REVISION OF THE FOSSIL HYMENOPTERA OF NORTH AMERICA. *I. Crabronidæ and Nyssonidæ.* By *A. S. Packard, Jr., M. D.* From the Proceedings of the Entomological Society. Philadelphia, 1866-67. pp. 167. 8vo.

This work treats of the classification of a large group of the fossorial or digging wasps. It contains descriptions of nearly all the genera and species known to inhabit North America. The species, as well as the genera of the digging wasps, are difficult to identify; but with the detailed descriptions of the genera here given, and the synoptical table of the species, the work of identification has been rendered comparatively easy. The names of species not seen by the author are added, so that it gives a complete list of all the known species, which amount to two hundred and seven, comprised in twenty-five genera, of which one new genus and fifty-eight new species are described. The family characters are discussed at length, and there are a few introductory pages devoted to the general classification of the group, their zoölogical characters, and geographical distribution.

NATURAL HISTORY MISCELLANY.

BOTANY.

HERBARIUM FOR SALE. — The collection of the Swiss botanist, the late M. Gay, is now offered for sale at the Jardin des Plantes, in Paris. This collection is of inestimable value, and embraces the whole European Flora. The author has worked upon it with rare patience and fidelity, adding to the description and analysis of each plant a complete list of the works in which it has been described; it contains ninety thousand different specimens. Dr. Henri de Saussure, from whom this information is derived, believes the Herbarium to be placed at the low price of 30,000 francs. Propositions from those wishing to purchase would be gladly entertained. Parties may address (post-paid) Dr. HENRI DE SAUSSURE, *Genthod, près Genève, Suisse.*

A FERN NEW TO OUR FLORA. — I enclose a specimen of a fern found in July, in shaded rocks at Berlin Falls, N. H., which I judge to be *Aspidium fragrans* Sw. (Gray's Manual, p. 598). As this fern is mentioned as occurring only in Wisconsin or high northward, the locality is perhaps new and worth noting. It occurs in the crevices of a perpendicular cliff a little below the falls, on the east side of the river; this cliff is plainly visible from the other bank. It is somewhat remarkable that the plant has not been before detected in so frequented a locality.

I found *Aspidium aculeatum* in a place called "the Gulch," about four miles from Gorham village; but this I believe has previously been found in the mountains. This gulch is an interesting place, where ice remains during the summer, and I regret that I had not time to explore it thoroughly.

I was engaged chiefly in looking for lichens, and I found, at Berlin Falls, an interesting plant, *Biatora lucida*, which is probably new to the White Mountain region. This pretty lichen is quite common on stones in walls in this vicinity (New Bedford). Professor Tuckerman, to whom I communicated it, at first pronounced it Arctic; but on seeing specimens, confirmed my determination. *Verrucaria margacea*, which was found by Mr. Tuckerman last season in the White Mountains, I found this summer at Clyde River Falls, Vermont, near Lake Memphremagog. At the base of "Owl's Head," on this lake, there is a cliff, the face of which is covered with *Placodium elegans* in large patches, giving it a very lively appearance. This lichen, I be-

lieve, does not usually occur so far from the coast."—H. WILLEY, *New Bedford, Mass.*

Mr. H. Mann, to whom we referred the specimen, says, "The fern (*Aspidium fragrans* Sw.) which Mr. H. Willey sends, is from quite a new, and therefore interesting locality, bringing it for the first time within the borders of New England. I believe it has not been found before on this side of the Saguenay River (where it is quite common), three hundred miles farther north."

A THORNLESS FORM OF THE HONEY LOCUST TREE.—I have been for the last three months watching a cluster of four Honey Locust trees on my farm that have no thorns. I thought that probably the thorns had been broken off by a large flood we had last September, and that new wood that might grow this spring would have thorns the same as others. There is now a fine growth of new wood, but no thorns on it. It is new to me, and others that I have had see them. Is it something unusual, or are they sometimes thornless?—J. HUGHES HUNT, *Harrison Junction, Ohio.*

A very obscure form without thorns, which by some is supposed to be a new species, has been known to exist in the Western States.—EDS.

MONSTROUS ROSES.—There is a small rose-bush in this village which bears flowers called "very double." Every summer, some of the blossoms send up a column or continuation of the receptacle from the middle of the flower. This column, after running up straight for half an inch, branches off and bears buds, which develop into small roses later than the first rose below. These "rosettes," or little roses if you like better, are as perfect as any flowers in the bush. In one instance, I counted seven little roses growing from the centre of a single flower. Another plant, in the same yard, this year produced a monstrosity a little different from the one above mentioned. The cup was very shallow and of thin texture. The points of the calyx were more leaf-like than common, one of the sepals having five leaflets, another four, another three, another two, and the other only one. Inside this calyx or whorl of leaves were plenty of petals, a few stamens, but the pistils were united into a column about half an inch long, nearly as large as the stem below the flower. This column had small prickles on two sides, and towards the top were some petals, colored on one edge, and green on the other, with fringes imitating leaflets on the green edge. At the top of the column appear five leaves, with stipules and leaflets in perfect condition. These are examples going to prove that "the blossom is a sort of branch, and its

parts leaves," and "that the receptacle of a flower is of the nature of the stem." See Gray's Botanical Text-Book, p. 230.—W. J. BEAL, *Union Springs, N. Y.*

IDENTIFICATION OF LICHENS BY A CHEMICAL TEST.—The Rev. W. A. Leighton continues his series of papers on this subject in the "Annals." He has lately given a notice of the Abbé Cœman's essay on the *Cladoniæ* of the herbarium of the great lichenologist, Acharius, and the results of the application to his own herbarium of a chemical test, as a means of deciphering species of Lichens. The reaction, which is found so useful, is that of hydrate of potash, which in certain cases produces a yellow color, whilst in others there is no reaction, or only a slight fuscescence. In no case, says Mr. Leighton, is the reaction of greater utility than in the difficult tribe of *Cladoniæ*, that *crux* of lichenologists, where its application enables us, with admirable precision and exactness, to determine the various species, to redistribute the confounded species, and to refer to their proper systematic places the innumerable varieties and forms which may resemble each other in external character.—*Quarterly Journal of Science, London.*

ZOÖLOGY.

THE BITTERN.—I notice in your August issue a letter from Mr. Endicott, in which he rather questions the accuracy of my account of the habits of the American Bittern (*Botaurus lentiginosus*), page 405, Ornithology of New England.

I am perfectly familiar with the meadows which Mr. Endicott refers to, have lived for eleven years within two or three miles of them, and have hunted them times innumerable. I never saw more than two Bitterns there in the area of a hundred acres, and doubt if any other person ever did. They seem to be most numerous in that locality in September, about the time of Snipe-shooting, and doubtless are then on the passage from the north. So I do not think it strange that Mr. Endicott has never met with many of the nests. But we cannot establish the habits of a species from individual cases, we must *generalize.*

The Bittern, as a general thing, in New England, judging from the observation of the majority of my friends and correspondents, and my own, oftener nests in bushes than on the ground, and in some localities it gathers in communities, scattered and detached if you will, but still communities, not of course extensive heronries, such as we see among the Night Herons and others, but still heronries.

Almost every nest that I ever saw or heard of was built in low

bushes or scrubby alders, usually overhanging the water. Sometimes a nest is found placed on the ground, or rather in a tussock of grass, but in such instances the meadow or swamp is comparatively dry, and not subject to inundations.

We cannot be too deliberate in forming conclusions on the habits of any animal, and our decisions must be made from numerous observations. What would Mr. Endicott say if I should affirm that the Dusky Duck (*Anas obscura*) — which is notoriously a ground nester — builds in high trees? yet Mr. George A. Boardman found one with her nest full of eggs in such a position; or that the Chipping Sparrow (*Spizella socialis*) nests in bushes? I have known it to; or that the Ruffed Grouse (*Bonasa umbellus*) lays in deserted crow's nests? I have heard of three instances; or that the Towhe Bunting (*Pipilo erythrophthalmus*) nests in low trees? it has been found to do so at Toronto. He would say, and so would any one, that I should not judge from one or two occurrences. — E. A. SAMUELS, *Boston*.

EGGS OF THE INDIGO BIRD. — Dr. T. W. Brewer, in the NATURALIST for May, doubted that any spotted eggs of the Indigo Bird (*Cyanospiza cyanea*) have yet been found. I have several specimens in my own collection, and have heard of others being found marked, decidedly, with spots of reddish brown. The following extract from a letter recently received from Mr. L. E. Ricksecker, of Nazareth, Pa., will furnish an instance: "I found a few days since the nest of an Indigo Bird, with four eggs, which are sprinkled with fine dots of pale-red, particularly at the greater end, where they form a circle. Being puzzled at first, I thought it might be a species new to me, whereupon I took my gun and shot the female as she was leaving the nest. She proves to be an Indigo Bird. I looked into your book to compare the eggs with your description, when I found that I had before sent you some specimens marked in a similar manner. I think the present set is rather more sprinkled than any I ever found." — E. A. SAMUELS, *Boston*.

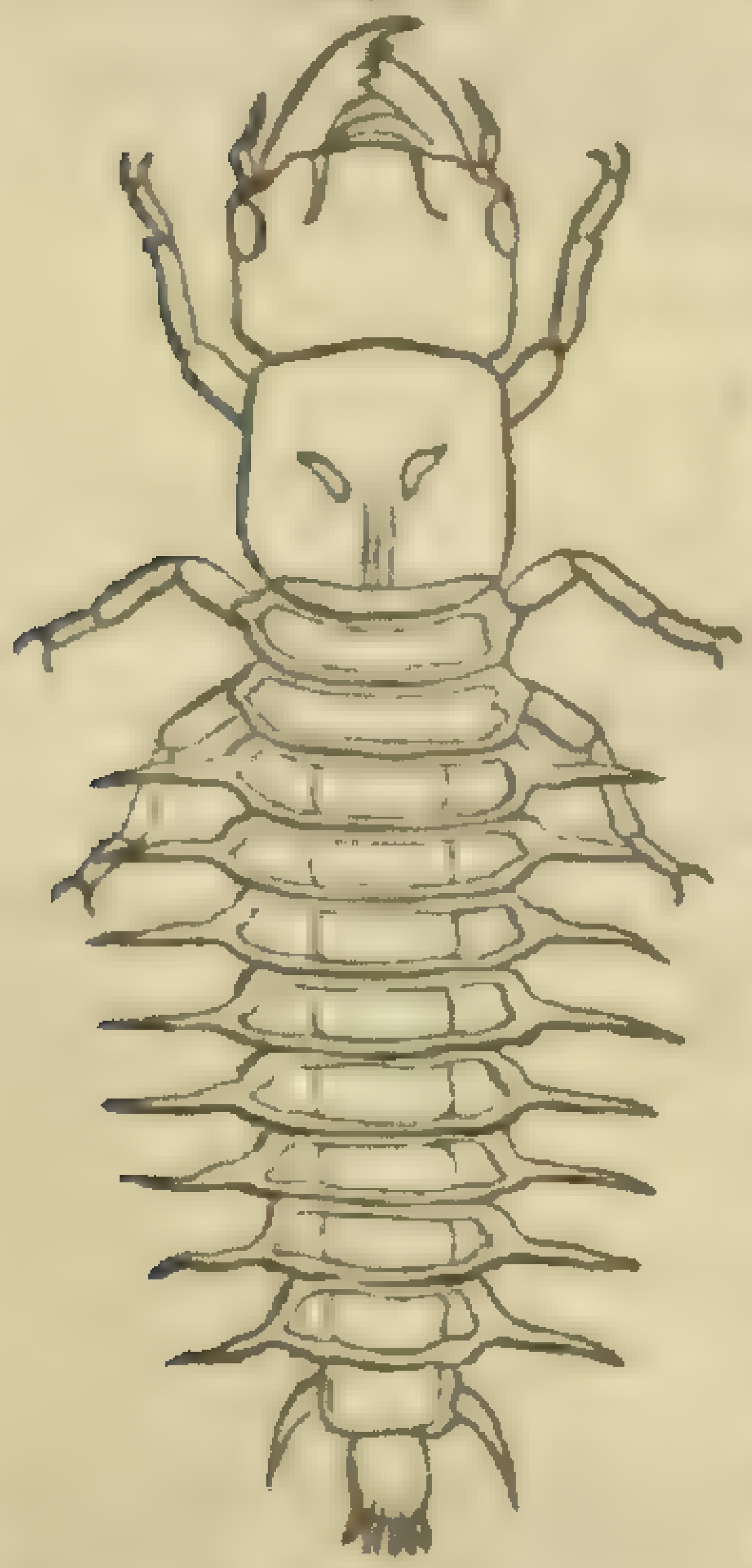
A SNAKE-LIKE CATERPILLAR. — The most extraordinary instance of imitation I ever met with [on the Amazon] was that of a very large caterpillar, which stretched itself from amidst the foliage of a tree which I was one day examining, and startled me by its resemblance to a small snake. The first three segments behind the head were dilatable at the will of the insect, and had on each side a large black pupilated spot, which resembled the eye of the reptile; it was a poisonous or viperine species mimicked, and not an innocuous or columbine snake; this was proved by the imitation of keeled scales on the crown, which was produced by the recumbent feet, as the caterpillar

threw itself backward. The Rev. Joseph Greene, to whom I gave a description, supposes the insect to have belonged to the family *Notodontidæ*, many of which have the habit of thus bending themselves. I carried off the caterpillar, and alarmed every one in the village where I was then living, to whom I showed it. It unfortunately died before reaching the adult form.—H. W. BATES, *Linnæan Transactions*, 1862, *p.* 509.

THE HORNED CORYDALUS.—One of the largest and most formidable looking, though perfectly harmless, insects we have, is the *Corydalus cornutus.* Its large size, its broad net-veined wings and slow-stupid flight, and aquatic habits, besides many other characteristics, place it very low in the scale of insect life. Insects like this were characteristic of the Coal Period, probably breeding in the marshes and fens of Carboniferous times. It is probable that the *Sialidæ*, the family to which this insect belongs, were much more numerous in those early ages of the world's history than now, as there are wide gaps between the genera, which, were the geological record complete, we could undoubtedly fill up.

We do not yet know how many eggs are laid by the parent, or their form and size. Those of *Sialis*, an allied genus, are cylindrical, terminating at the top in a sudden point, and are attached, side by side, to plants with the greatest regularity, according to Westwood.

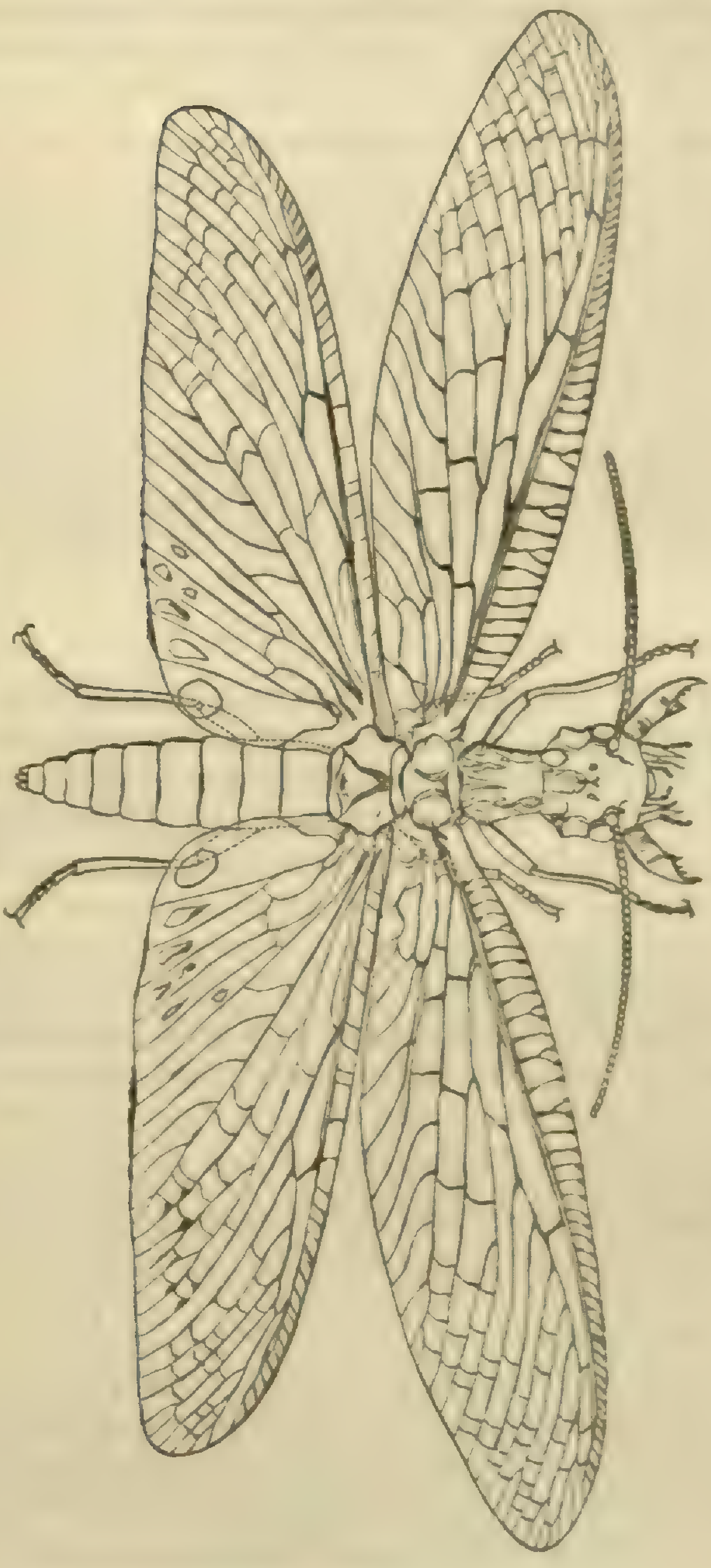
Fig. 2.



The larva (Fig. 2) is broad and flattened, with a pair of long, thick respiratory filaments attached to the side of each ring of the abdomen, and the body ends in a pair of legs with strong claws, which the artist has not represented in our figure. It is very fierce and active in its habits, moving over the bottom of pools, and preying on other insects, which it seizes in its powerful jaws. When of full size, it leaves the stream or pool in which it has been living, and makes an earthen cell in the bank, in which the inactive pupa undergoes the rest of its transformations. Our figure (Fig. 1, from Sanborn) of the perfect insect represents the female. In the male, the jaws are nearly as long as the antennæ, and much like them in form, being very slender.

BREEDING PLACE OF THE PELICAN.—In your August number appears a statement of Mr. Beal in regard to the White Pelican captured in Cayuga county, in which he copies the following extract from Professor Baird's account of the bird, in reference to its breeding habits:

Fig. 1.



THE HORNED CORYDALUS.

"This species breeds in the fur countries, generally selecting inaccessible places in the neighborhood of waterfalls." From the above it it would seem that this bird only breeds in the countries far to the north. Now this bird breeds abundantly on the sand-bars opposite New Found Harbor, in Indian River, Florida. They lay their eggs about the middle of May on the bare sand, making no nest whatsoever.—CHARLES H. NAUMAN, *Lancaster, Pa.*

GENERIC AND SPECIFIC NAMES.—The scientific name of an animal or plant consists of two names, the *generic* and *specific*, which are given in Latin, as being, by universal consent, the most convenient medium between naturalists of different nations. Thus the scientific name of the Lion, is *Felis leo* Linn. *Felis* is the name of the genus, and *leo* is the name of the species. Linn. stands for *Linnæus*, being either the founder of the entire name, or the first one to describe the species scientifically. So also with the name *Helix albolabris* Say. Mr. Say was the first author to describe our common White-lipped Snail belonging to the genus *Helix*, and species *albolabris*.

ANALOGY AND HOMOLOGY.—Analogy is a resemblance in function between parts differing anatomically, and constructed on wholly different types. Thus the wing of the butterfly is *analogous* to the wing of a bird. In this sense must be understood the comparison made by Oken, between the pupa, or chrysalis, of an insect, and a crustacean, such as the Shrimp. The resemblance is vague, but yet sufficiently apparent to many to enable the two things to be thus compared.

The term *Homology* indicates an identity between the structure of certain parts, though the functions they perform may be quite different. Thus the arm of man and a bird's wing are said to be *homologous*, since their anatomical structure is fundamentally the same, though their uses are so different.

THE AQUARIUM.—In the matter of cementing aquaria, I have had considerable experience. I have always found white lead of any kind bad. I sent to England and paid a good price for a "secret" cement of one of the leading dealers, but found it useless, as it contained white lead or litharge. The best cement is applied *hot*. Marine glue, when it can be got, would answer capitally; but I have found a mixture of pitch, tallow, and umber melted and poured on good. I prefer to cover the corners and bottom with glass, and use an iron frame and bottom. Thus we have a strong and light-looking affair, which can be scrubbed with sand internally, as is sometimes desirable. By far the best aquaria I ever saw were made by the well-known bookseller, C. E. Hammett, of Newport, R. I.—A. M. EDWARDS, *New York.*

TEACHING OF NATURAL SCIENCE IN PUBLIC SCHOOLS.—In a paper read before the British Association, Rev. W. Farrar "expressed his conviction of the necessity and desirability of extensive education in physical science." Dr. Hooker "considered chemistry as too rigid a study for a young boy to commence with, and thought botany and zoölogy should be the first studies." Professor Tyndall "had often witnessed the deep interest boys took in the study of physics, when properly opened to them. The habit of verification by experiment, and the consciousness of a power of prediction, were most important characters to implant in the mind; but this could only be done by a true and philosophic study."

METHOD OF OBTAINING A NEW QUEEN BEE FROM WORKER-GRUBS.—Mr. Tegetmeier has described a practical application of Shirach's discovery respecting the power of bees to raise a new queen from a neuter or worker grub, by means of which the contents of old hives can be taken without destroying the bees or sacrificing any brood:—

"The plan consists in driving out the queen, and about half the bees in the spring, and establishing them as a new swarm, when the bees remaining in the old hive have to raise a new queen from a worker grub. From the time required to accomplish this, it follows that no egg can be laid for about three weeks; by this time the workers, proceeding from eggs laid by the old queen, will have been hatched out, and the cells filled with honey, when the whole of the bees are to be driven out, and the honey, which will be found perfectly free from brood, retained for use."—*Proceedings of the Entomological Society of London.*

NOVEL WAY OF SHOOTING EAGLES.—Hunters find it a very easy matter to shoot the Bald Eagles, which are occasionally found in winter along the shores of Cayuga Lake. They approach the birds on horseback, to within fifteen or twenty yards, and then slide from the horse and shoot them at their leisure.—W. J. BEAL.

GEOLOGY.

ORIGIN OF LIFE ON OUR GLOBE.—With regard to the origin of life on our globe, M. Figuier does not dogmatize:—Did plants precede animals, we cannot tell, but such would appear to have been the order of creation." Our globe, he thinks, during the Cambrian and Silurian periods, was not yet mature enough for the existence of the higher organisms. "A pale sun struggled to penetrate the dense atmosphere of the primitive world, and yielded a dim and imperfect light to the first created beings as they left the hand of the Creator, organisms often rudimentary, but at other times sufficiently advanced to indicate a progress towards most perfect creations." The absence of organisms more advanced in the zoölogical scale than were the Trilobites, is no proof that more highly organized animals did not exist on the globe during the Cambro-Silurian period. Those who

think the Darwinian theory approximates to the truth, and especially those who hold the "complete" theory, will of course believe, that animals, classed as high among the Vertebrata as the Trilobites and Cephalopoda of Lower Silurian rocks are among the Annulosa and Mollusca, existed at that time in regions of the globe from which the ocean, perhaps, forever excludes the inquiring palæontologist from verifying his conjectures. The discovery of the Eozoon Canadense in the Laurentian rocks, and the existence of beds of limestone in the same system, seem to confirm the views of those who regard the whole of the sedimentary rocks, from the Silurian and Cambrian upwards to the latest Tertiary beds, as including but a partial and fragmentary record of the past life of the globe,—impressions of the last-formed links of the great chain of organic life on our planet,—a few of the last chapters in the book of "Ancient Life."—*Quarterly Journal of Science, London.*

MICROSCOPY.

PREPARATION OF SNAILS' TONGUES.—I present a plan devised many years ago, for such small forms as *Littorina* and the like, whose lingual ribbons are extremely tender, and difficult to see as well as handle. I use a rather strong solution of caustic potassa, the strength of which I cannot exactly specify, as it must vary with the species under manipulation, some having ribbons of such strength that they will bear the very strongest solution, while others will be injured by immersion in a comparatively weak liquid. Into this solution in a test tube or other convenient vessel, plunge the whole animal; in the case of the smaller creatures, shell and all. The specimen may be fresh, or preserved in alcohol, but on the former the potassa will act most vigorously. I have found that one good way is to let the animal stand in the shell until it dies and begins to decompose, when it can readily be removed, and falls in pieces. The lingual ribbon, as a general thing, is not easily decomposed. Now either set the potassa solution, with the animal in it, aside for some days, or boil it at once. You will then find that almost everything dissolves and becomes "soap," except the shell and operculum, a few shreds of muscular fibre, and the prized lingual ribbon. Frequent washing with fresh water now removes all the alkali, and leaves the teeth clean and in perfect order. It can then be mounted in any preservative fluid which is miscible with water, and is best removed to alcohol to be kept until it is mounted. To mount it, remove it from the spirit, and without drying plunge it in pure spirits of turpentine, in which it should be boiled for a short time to drive off some of the alcohol. It can now

be mounted in Canada balsam, when it shows all its beauties in a remarkable manner, and, at the same time, shows its effects on polarized light. I would say, that the potassa cleans the shell and operculum beautifully. — A. M. Edwards, *New York.*

The Movements of the Diatomaceæ. — The movements of the Diatomaceæ still continue to puzzle microscopists, and various explanations of this phenomenon have been advanced. Professor Schultze has carefully studied a number of species, *Pleurosigma angulatum*, *Pleurosigma fasciola*, *Nitschia sigmoides*, *Surirella bifrons*, and others, making various experiments and observations upon them. He is led from these researches to conclude that a glutinous organic substance, which is concerned in rapid movement, is spread over the external surface of the Diatomaceæ. It is by this protoplasmic sheath that the *Bacillariæ* become adherent to one another. Professor Schultze does not consider that this view affects the question of the animal or plant nature of diatoms. He considers that they must be left with some other unicellular beings, as of "uncertain kingdom," until we know more of what constitutes the boundary, if there be any, between plants and animals. — *Quarterly Journal of Microscopical Science.*

ANSWERS TO CORRESPONDENTS.

J. T. M., Grand Isle, Vt. — The land snails sent for identification are as follows: The "largest, No. 1," is *Helix concava* Say. The "horn-colored, No. 2," is *Helix chersina* Say. The "small reflected lipped, No. 3," is *Helix minuta* Say. The "light-colored conical-shaped, No. 4," is *Pupa pentodon* Say. The late fall months will be found a very favorable time for collecting, as the leaves, having fallen, no longer obstruct the light, and the snails can be easily detected by turning up the damp layers in hard-wood growths.

D. S. C., Rockport, Ill. — "Essay on Classification," by Professor Agassiz, was published separately in London; Longmans & Co., 1859. You can undoubtedly obtain it by ordering of any prominent bookseller in New York. The cheapest form of cabinet for geological specimens is an upright case of shelves, like a bookcase. The shelves to be inclined, or to have separate steps on each shelf. For a conchological case, make a set of shallow drawers, 18x24 inches, and from two to five inches deep. For exhibition, nothing is better than a horizontal show-case, though this takes up a great deal of room.

E. L. M., New York. — Besides the works on Entomology already mentioned in the Naturalist, you need the works on American

Entomology, published by the Smithsonian Institution, Washington, D. C. Send for its list of works for January, 1866, with the prices attached. We intend hereafter to publish in the NATURALIST an extended list of the most important works on Insects.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.—The Sixteenth Annual Meeting was held at Burlington, Vermont, commencing on Wednesday, August 21, and continuing until Monday night, August 26, 1867.

In September, 1847, the "Association of American Geologists and Naturalists" resolved itself into the "American Association for the Advancement of Science." The new organization held its first meeting at Philadelphia, September, 1848. The objects of this Association are the holding of annual and migratory meetings, to promote intercourse between those who are cultivating science in different parts of the country, and to give impulse, system, facility, and wider usefulness to the labors of scientific men.

About seventy-five members from various parts of the country were in attendance during the five days' session at Burlington, and many interesting papers were read and freely discussed during the meeting.

The Association held its meetings in the rooms of the City Hall, the Court House, and the vestry of the Third Congregational Church, under the auspices of the Local Committee. Each morning there was a general meeting for business, and then the members adjourned to SECTION A,—*Mathematics and Physics*; or to SECTION B,—*Natural History and Geology*, as their tastes inclined.

On Friday evening, the President, Professor J. S. NEWBERRY, of Columbia College, New York, gave an address on *Modern Scientific Investigation—its Methods and Tendencies.* His address applied to the whole range of the sciences. It was comprehensive, profound, and ably written, and gave great satisfaction to the members present. This address will be published in full in the next number of the NATURALIST.

On Saturday, after a short session in the morning, the Association and their friends accepted the invitation of the Champlain Transportation Company, and made an excursion to the Au Sable Chasm, in Keeseville, New York, a singular and very beautiful chasm in the Potsdam rocks, through which the Au Sable River makes its way to the Lake.

In our next we shall endeavor to give abstracts of the various papers read before the NATURAL HISTORY SECTION, only having space in this number for their titles.

FIRST DAY.

The Distribution of Precious Metals in the United States. By Col. CHAS. WHITTLESEY.

SECOND DAY.

The Geological Relations of the Mastodon and Fossil Elephant of North America. By Prof. JAMES HALL.

Considerations drawn from the Study of the Orthoptera of North America. By SAMUEL H. SCUDDER.

Traces of Ancient Glaciers in the White Mountains. By G. L. VOSE.

The Origin of the so-called Lignilites or Epsomites. By Prof. O. C. MARSH.

The Geographical Distribution of the Sediments and the Fossils of the Hamilton, Portage, and Chemung groups of New York. By Prof. JAMES HALL.

The Distribution of Limnæa megasoma and cognate genera. By L. E. CHITTENDEN.

THIRD DAY.

Tellurium a Metal. By Prof. L. Bradley.

Upon some remarkable Fossil Fishes obtained by Rev. H. Herzer from the Devonian Rocks at Delaware, Ohio. By Prof. J. S. NEWBERRY.

The Fossil Insects of North America. By S. H. SCUDDER.

The Winooski Marbles of Colchester, Vt. By Prof. C. H. HITCHCOCK.

The Zoological affinities of the Tabulate Corals. By Prof. A. E. VERRILL.

The Coal Measures of Illinois. By Prof. A. H. WORTHEN.

New Points in the Geology of Nova Scotia and New Brunswick. By Prof. J. W. DAWSON.

FOURTH DAY.

On some New Fossil Sponges from the Lower Silurian. By Prof. O. C. MARSH.

On the occurrence of Fossil Sponges in the successive groups of the Palæozoic Series. By Prof. JAMES HALL.

The American Beaver. By LEWIS H. MORGAN.

The Distortion and Metamorphosis of Pebbles in Conglomerates. By C. H. HITCHCOCK.

FIFTH DAY.

On some Fossil Reptiles and Fishes from the Carboniferous Strata of Ohio, Kentucky, and Illinois. By Prof. J. S. NEWBERRY.

Cotta's Law of the Earth's Development. By R. W. RAYMOND.

On Mountain Masses of Iron Ore in the United States. By Col. CHARLES WHITTLESEY.

On the Lower Silurian Brown Hematite Beds of America. By B. S. LYMAN.

Explanations of the Geological Map of Maine. By Prof. C. H. HITCHCOCK.

On the Geographical Distribution of Radiates on the West Coast of America. By Prof. A. E. VERRILL.

Considerations relating to the Climate of the Glacial Epoch in North America. By Prof. EDWARD HUNGERFORD.

Depression of the Sea during the Glacial Period. By Col. CHAS. WHITTLESEY.

Ripton Sea Beaches. By Prof. EDWARD HUNGERFORD.

On the Cretaceous and Tertiary Flora of North America. By Prof. J. S. NEWBERRY.

On certain Effects produced upon Fossils by Weathering. By Prof. O. C. MARSH.

Geology of Vermont. By Prof. C. H. HITCHCOCK.

The Insect Fauna of the summit of Mount Washington as compared with that of Labrador. By Dr. A. S. PACKARD, jr.

Remarks on the Ichthyological Fauna of Lake Champlain. By F. W. PUTNAM.

The Embryology of Libellula (Diplax?), with notes on the Morphology of Insects, and the classification of the Neuroptera. By Dr. A. S. PACKARD, jr.

On the Flowering of Plants. By JAMES HYATT.

The following Resolution was proposed by Prof. O. C. MARSH, of Yale College, —

Resolved, That the chair appoint a commission of nine members to examine the Linnæan rules of Zoological Nomenclature by the light of the suggestions and examples of recent writers, and to prepare a code of laws and recommendations in conformity with the best modern usage, to be submitted to the Association at the next annual meeting; the committee to have authority to fill vacancies and increase their number to twelve, if deemed advisable.

This Resolution was unanimously adopted, and the chair appointed the following committee:—Prof. J. D. DANA, of Yale College; Prof. JEFFRIES WYMAN, of Harvard University; Prof. S. F. BAIRD, of the Smithsonian Institution; Prof. JOSEPH LEIDY, of the Philadelphia Academy of Natural Science; Prof. J. S. NEWBERRY, of Columbia College; Prof. J. W. DAWSON, of McGill College, Montreal; Dr. WILLIAM STIMPSON, of the Chicago Academy of Science; S. H. SCUDDER, of the Boston Society of Natural History; and F. W. PUTNAM, of the Essex Institute.

Dr. HENRY WHEATLAND, Secretary of the Essex Institute, offered a resolution, which was unanimously adopted, tendering the thanks of the Association to GEORGE PEABODY, Esq., for his munificent donations, amounting to over four million of dollars, for the increase of science and education in the United States.

The President was requested by the Association to forward a copy of the resolution to Mr. Peabody.

After the adjournment of the meeting on Monday night, the members met at the house of Dr. WM. C. HICKOK, and passed the few last hours of their stay in Burlington most pleasantly.

On the following day a number of the members accepted the invitation of W. H. H. BINGHAM, Esq., to visit Mt. Mansfield, where they were most cordially entertained.

The next meeting will be held at Chicago, commencing on the first Wednesday of August, 1868.

The following are the officers for the next meeting:—

President, Dr. B. A. GOULD, Cambridge. *Vice President*, Col. CHAS. WHITTLESEY, Cleveland, Ohio. *Permanent Secretary*, Prof. JOSEPH LOVERING, Cambridge. *General Secretary*, Prof. A. P. ROCKWELL, New Haven. *Treasurer*, Dr. A. L. ELWYN, Philadelphia.

The Association were invited to hold the meeting of 1869 in this city (Salem), and should they accept, as we earnestly hope they will, we know they will be most cordially welcomed by our citizens.

BOSTON SOCIETY OF NATURAL HISTORY. *March* 20, 1867.—Mr. A. L. Fleury, of New York, read an essay entitled: "Rocks in Nature and in the Arts," treating of the physical and chemical properties of

quartz, and the theories proposed to account for its origin. Observing that in nature quartz-rock is often dissolved in water by the formation and subsequent decomposition of sulphide of silicum, either with or without alkaline agency, he showed how we might follow the path thus indicated, and produce, artificially, a liquid hydrate of silica.

The Secretary read a paper by Col. Whittlesey, of Cleveland, on the weapons and military character of the Race of the Mounds. The author brought to notice the curious fact, that while extensive fortifications built by the Mound race remain scattered over the plains of Ohio, no weapons formed exclusively for warfare have yet been discovered, nor are there any indications that the defences have ever been attacked. He concluded that the weapons were probably made of wood, and that the fortifications were abandoned on the approach of the foe. He also remarked that while in Europe ethnological writers distinguish the progress of mechanical arts among men as the ages of Stone, of Bronze, and of Iron, in the Western States the ancient inhabitants did not follow this order of progress, but rather retrograded. He believed that the European age of Bronze corresponded to the age of Copper in this country, to which the age of Stone has *succeeded*, and that to this age the Indians of the present day belonged.

April 4, 1867.—Mr. James G. Swan presented a paper on the Meteorology of Cape Flattery, Washington Territory, the result of personal observation of the thermometer and rain gauge for three consecutive years.

Dr. Andrew Garratt exhibited a bony mass taken from the interior of the heart of a right whale; it was attached by two knoblike projections to the base of the valves, and hung free in the cavity of the heart. On examination, Dr. J. C. White had found it to be composed of an external shell of fibrous tissue, dense and glistening like parchment, and an interior spongy mass of a brownish and somewhat fatty substance; it seemed to be a coagulum of fibrine, or possibly a pathological growth from the valves of the heart.

At the last meeting of the Section of Entomology—records of which were read at this time—Mr. S. H. Scudder exhibited drawings and specimens of fossil insects from the Devonian rocks of New Brunswick. Six tolerably well-preserved specimens had been obtained by Mr. C. F. Hartt, all belonging to the Neuroptera, or lace-winged flies, but differing greatly from any now living. They were the earliest traces of insect life yet discovered, the oldest insects previously known having been found in the Carboniferous strata.

Mr. Scudder exhibited a photograph of another fossil wing, found in the Carboniferous rocks of Cape Breton. It was simple in structure, of gigantic size, and probably belonged to the May flies.

Some notes of a visit to the Pinjrapal, or animal hospital of Bombay, were read by Mr. W. T. Brigham. A space of six or seven acres in the heart of the city was enclosed, and divided into wards, for the reception of sick and helpless animals; cattle, deer, dogs, goats, monkeys, and even tortoises, had all their separate abodes; fish, too, rescued from impending death by the pious Hindoos, whose religion forbids the destruction of animal life, swam unmolested in their proper tanks. No surgical aid seemed to be given, but the animals were well fed and cared for by a large staff of attendants or nurses. There are several of these establishments in India, supported by the donations of wealthy Hindoos.

April 18, 1867. — Dr. Jeffries Wyman gave an account of an excursion he had recently made to the St. John's river, Florida, for the purpose of examining the Indian antiquities of that region. His attention was especially given to the shell mounds. These mounds are of two kinds; those on the sea-coast, made up of *marine* shells, as at Fernandina and St. John's bluffs, and those found inland, which are composed entirely of *fresh-water* shells. Twenty-eight of the latter, situated between Pilatka and Salt Creek, were examined. Although they have not hitherto been attributed to the aborigines, there is abundant evidence that Indians lived upon them from their commencement up to the time of their completion: pottery, bones of edible animals, such as deer, wild turkeys, ducks, soft-shelled turtles and catfish were scattered throughout their whole extent. Beds of charcoal were found at various depths resting on calcined shells, and near them were fragments of burnt bones. Ornaments and flint implements were very rare, but a few miles above Pilatka, a worked flint was discovered in the sand under a shell mound eight feet high. The shells were principally univalves of the genera *Ampullaria* and *Paludina*, with some fresh-water mussels, *Unionidæ*.

The age of these mounds was not determined, but the occasional occurrence of live oaks five feet in diameter proved that the mounds had not been materially increased since the advent of the white man, more than three centuries ago.

There was a marked variety in the fragments of pottery belonging to different localities. Specimens from the upper portion of the river were slightly ornamented by square and regular indentations; those from the neighborhood of Lake Munroe were marked by complicated figures, traced on the clay with a pointed instrument, while near the

mouth of the river these patterns became still more elaborate, and in almost every instance the clay, forming the earthen ware, was mixed with sand. This was rarely the case in specimens obtained from the upper waters.

Academy of Sciences. *Chicago, June* 11, 1867.—The Secretary presented a paper entitled "Contributions to Comparative Geography," by Dr. Herman Haig, accompanied by a letter from the author, in which he stated that he had submitted the same to Humboldt shortly before his death, but that the paper had been returned unopened. He now desired to lay it before the Academy in the hope that his discoveries would meet with public recognition through their means. On motion, the paper was referred to a committee of three, consisting of Dr. Rauch, Professor Stimpson, and Professor Daniels.

A paper was presented from Charles A. White, M. D., and O. H. St. John, entitled, "Descriptions of New Subcarboniferous and Coal Measure Fossils, collected upon the Geological Survey of Iowa, together with a notice of new generic characters observed in the species of brachiopods."

July 9.—The Secretary read abstracts of a couple of papers by Professor T. H. Safford, one on the motion of the solar system in space, and the other relative to observations on nebulæ with the large reflectors of the Dearborn Observatory. The papers were referred to a special committee, composed of Dr. Blaney and the Secretary.

Dr. Blaney then made some remarks on the spectral analysis, the manner of using it, and the purposes for which it was employed.

The presiding officer spoke in reference to the continued discoveries of silver in Colorado.

Dr. Blaney reported that he had assayed some chips taken from the bottom of a well in Canada, dug down three feet deep in the rock, and got out $9 in silver. The well had been dug under spiritual guidance.

Remarks were made by the presiding officer and Dr. Blaney, relative to salt deposits in the Western Territories, after which the meeting adjourned.

Academy of Natural Sciences of Philadelphia. *March* 19, 1867. Prof. E. D. Cope presented to the Academy a young specimen of the Whale, known as the Bahia Finner, procured near Bahia, Brazil; the length was twenty-one feet. It was shown to belong to the genus *Megaptera* Gray, the Hump-back Whale of sailors.

Dr. Leidy exhibited a number of plates of a forthcoming work on the extinct mammals of Nebraska and Dacota, among which was

one representing an almost complete skull of an animal, which he characterized under the name of *Agriochœrus latifrons*.

Prof. Ennis inquired whether remains of the Hippopotamus had been found in this country. Dr. Leidy replied that no evidence existed of the animal, though Mr. J. A. Conrad had at one time a tooth which he considered to have belonged to the Hippopotamus.

April 9, 1867. — Professor H. C. Wood, jr., presented a paper entitled, "Description of New Species of Texan Myriapoda."

A paper was read from Isaac Lea, LL. D., on two new minerals (*Lesleyite* and *Patersonite*), from Chester county, Pennsylvania.

Professor Ennis spoke of the "Geological Changes resulting from the rise and fall of the Ocean level;" also upon the "Natural History of Man."

Professor Cope exhibited several vertebræ of a new species of Gavial (*Thoracosaurus brevispinus* Cope), from the cretaceous marl of Burlington county, New Jersey.

April 23, 1867. — Mr. J. Cassin read a paper entitled, "A third Study of the Icteridæ — Sub-family Icterinæ.

BOOKS RECEIVED.

Petroleum in North America. By Professor C. H. Hitchcock. (Extracted from the Geological Magazine, January, 1867.) 8vo, pp. 3.

Some account of Barettia, a new and remarkable Fossil Shell from the Hippurite Limestone of Jamaica. By S. P. Woodward. Reprinted from the Geologist, 1862. Plate 1, 2. 8vo, pp. 8.

On some Points in the Structure of the Xiphosura, having reference to their relationship with the Eurypteridæ. By Henry Woodward. (From the Quarterly Journal of the Geological Society for February, 1867.) Plate 1, 2. 8vo, pp. 9.

Some Observations on the Zoantharia Rugosa. By Gustave Lindström, Ph.D. One plate. (Extracted from the Geological Magazine, Aug. and Sept., 1866.) 8vo, pp. 14.

Quarterly Journal of Science. April, 1867. London.

Results of Meteorological Observations made at Brunswick, Maine, between 1807 *and* 1809. By Parker Cleaveland, LL. D. Reduced and discussed by Charles A. Schott. From the Smithsonian Contributions. 1867.

The American Bee Journal and Gazette. Vol. II. No. 13, July, August, 1867.

The Chemical News and Journal of Physical Science. Vol. I. No. 1, 2. July, August, 1867.

Prize Essay on Medical and Vital Statistics. By F. B. Hough, M. D. Albany, 1867. 8vo, pp. 37.

Notes on Wilson's Readers. By S. S. Haldeman. 1866. 8vo, pp. 24.

State Geological Survey of Iowa. Preliminary Notice of New Genera and Species of Fossils. By C. A. White, M. D., State Geologist, and O. H. St. John, Assistant. 8vo, pp. 2.

A Third Study of the Icteridæ. By John Cassin. 1867. 8vo, pp. 74.

On Colonies of Plants observed near Philadelphia. By Aubrey H. Smith. 1867. 8vo, pp. 10.

Ambas Americanas, Revista de Educacion, bibliografia i Agricultura, bajo los Auspicios de D. F. Sarmienta. Volumen I. Nueva York, 1867. 8vo.

Chemistry of the Farm and the Sea, and other familiar Chemical Essays. By J. R. Nichols, M. D. Boston, 1867.

THE

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MODERN SCIENTIFIC INVESTIGATION: ITS METHODS AND TENDENCIES.*

BY PROF. J. S. NEWBERRY.

Gentlemen of the American Association for the Advancement of Science: Every day of our lives we hear that this is an age of *progress;* and that it is so we find evidence at every turn. The rapidity with which effects follow causes in human events, the celerity with which the plan is carried into execution, gives to a *year* in the experience of one of the present generation the practical value of a lifetime in ages past. Much labor has been expended on the exposition of the causes of the mental activity of the present age, and of the grand achievements which have attended it; and yet, the key to the whole enigma is to be found in the universal adoption of the comparatively new system of inductive reasoning. It would be foreign to my purpose to attempt to illustrate or defend this proposition, and I must therefore trust to its acceptance without argument, while we pass to con-

* Annual Address of the President, delivered at the Meeting of the American Association for the Advancement of Science, held at Burlington, Vt., August, 1867.

Entered according to Act of Congress, in the year 1867, by the Essex Institute, in the Clerk's Office of the District Court of the District of Massachusetts.

sider that branch of the subject which more immediately demands our attention.

Although the progress of the age to which I have referred has been a matter of wonder and delight to all students of humanity and civilization, many of our best men have been somewhat alarmed and dizzed by it; and while accepting the achievements of modern industry and thought as full of present good and future promise, they are not a little concerned lest our railroad speed of progress should lead to its legitimate consequences, a final crash—not of things material, but of those of infinitely more value—of opinions and of faith. As often as it is boasted that this is preëminently an age of progress, that boast is met by the inevitable "but" (which qualifies our praise of all things earthly) "it is equally an age of scepticism." For the truth of this assertion the proof is nearly as palpable as of the other; and in view of the ruthlessness with which the man of the present removes ancient landmarks and profanes shrines hallowed by the faith of centuries, it is not surprising that many of the good and wise among us should deplore a liberty of thought leading, in their view, inevitably to license; and mourn over this wide-spread scepticism as an evil and inscrutable disease that has fallen upon the minds and hearts of men.

Now for every consequence there must be an adequate cause; and while confessing the fact of this modern lack of faith, I have thought that a few moments given to an analysis of it, and an attempt to trace it to its source might not be wholly misspent,—might possibly, indeed, result in giving a grain of encouragement to those who look with distrust and dread upon the investigations and discussions which now occupy so large a portion of the time and thought of our men of science.

If the wheels of time could, for our benefit, be rolled back, and we could see in all its details the civilization of Europe three or four hundred years ago, we should find that our so much respected ancestors, who fill so large a space on the page of history, were little better than barbarians. Among the English, the French, the Germans, Spanish and Italians we should find a phase of civilization which, excepting that it included the elements—as yet but imperfectly developed—of a true religious faith, is scarcely to be preferred to that of the Chinese. Aside from the vast difference perceptible between the civilization of that epoch and ours, as exhibited in the political condition of the people, in their social economy and morals, the general intellectual darkness of the period referred to could not fail to impress us both profoundly and painfully. Out of that darkness and chaos have come, as if by magic, all our modern democracy with its individual liberty and dignity, all our civil and religious freedom, all our philanthropy and benevolence, all our diffused comfort and luxury, most of our good manners and good morals, and all the splendid achievements of our modern scientific investigation.

It is unnecessary for me here to describe in detail the origin and growth of modern science. That has been so well done by Dr. Whewell that all men of education are familiar with the steps by which the grand, beautiful, and symmetrical fabric formed by the grouping of the natural sciences has acquired its present lofty proportions.

Previous to the period when the Baconian philosophy was accepted as a guide in scientific investigation, but one department of science had attained a development which has any considerable claim to our respect. Mathematics, both pure and applied, had been assiduously cultivated

from the remotest antiquity, and with a degree of success which has left to modern investigators little more than the elaboration of the thoughts of their predecessors. In Metaphysics—which had claimed even a larger share of the attention of the scholars of antiquity—little progress had been made. Perhaps I am justified in saying little progress was possible, inasmuch as in the light of all the great material discoveries of modern times the metaphysicians of the present day are debating, with as little harmony of opinion, the same questions that divided the rival schools of the Greeks. Each successive generation has had its two parties of idealists and realists, who have discussed the intangible problems which absorbed the great minds of Plato and Aristotle with a degree of enthusiasm and energy—and it may be of acrimony—which seems hardly compensated by any expansion of the human intellect or amelioration of the condition of mankind.

Of the *physical sciences* we may say that, except Astronomy, no one had an existence prior to the time of Bacon. There were men of vast learning, and much that was *called* science in the mass of reported observation that had been accumulating from century to century, until it had become "*rudis indigestaque moles*," in which—though it constituted the pride of universities, the intellectual capital with which the savant thought himself rich, and that on which the professional man depended for success—there was far more error than truth, and of which the study was sure to mislead and likely to injure. In these circumstances the task before the scientific reformer was one far more difficult than that of clearing the Augean stables; no less, in fact, than to seat himself before this great heap of rubbish, this mass of truth and error,—of the sublimest philosophy with the wildest fiction,—to pa-

tiently winnow out the grains of truth, and from infinitesimal facts build up a fabric that should have a sure foundation below, and beauty and symmetry above. What more natural, then, than that the process adopted in winnowing this chaff-heap should be that which had given success to the only true science of the period?—that the mathematical touchstone should be the test by which every grain was tried? And such precisely was the course pursued; perhaps we may even say the only one practicable. Provided with this test, the reformer was compelled to rejudge upon its merits every proposition submitted to him, and accepted only as true such as could be demonstrated. The materials which composed the science to be reformed naturally fell into several categories. First,—That which had been *demonstrated* to be true. Second,—That which was *demonstrable*. Third,—That which was *probable*. Fourth,—That which was *possible*, and Fifth,—That which was *impossible*. Of these he systematically rejected all but the first and second classes. And this, in few words, has been the method adopted, not only in the purification of old science, but in the creation of new.

It will be seen at a glance, that in this process all that was contrary to the order of nature (supernatural or spiritual) was necessarily excluded; and it was taken for granted that the mathematical or logical faculty of the human mind was capable of solving *all* the problems of the material universe. Sir William Hamilton and others have demonstrated the inadequacy of mathematical processes as a guide to human reason, and a moment's thought will show us that our boasted intellect is incapable of grasping even all the material truths which are plainly presented to it. To illustrate: as we scan the

heavens of a clear evening, we recognize the fact that we stand as it were on a point in space, where our field of vision is limitless; the heavenly bodies stretching away into the realms of obscurity, and becoming invisible only through the imperfection of our organs of vision. Bringing to our aid the most powerful telescopes, we are apparently as far as ever from reaching the limits of the universe; and when we endeavor to *conceive* of such a limit, the reasoning faculty finds itself incapable of grasping either of the two alternatives offered to it, one or the other of which must be true. The universe must be either limited or limitless. But no man can conceive of a universe without a limit; and if it be regarded as terminated by definite boundaries, the imagination strives in vain to fill the void which reaches beyond. In fact we stand here face to face with infinity, and recognize the fact that the infinite exists without the power to comprehend it.

The same is true of time. We cannot conceive of its beginning or its end. All things which come within the scope of our senses are limited in duration and circumscribed in space, and though we prate flippantly of the infinite, the pretence that we can grasp it is simply idle talk.

Conducted on such a plan, it was inevitable that scientific investigations should be narrow and materialistic in their tendency. No matter how strong the probability in favor of the truth of a certain proposition,—though the whole fabric of society were based upon its acceptance, and it formed the foundation of civil and moral laws, controlling the actions of the philosopher himself,—if not proved consistent with nature's physical and material laws it must be rejected as unworthy to enter into the con-

struction of the edifice he was erecting. In his great task of undoing the work of blind, unreasoning faith, and wild, illogical speculation, all the fruit of such faith or speculation must be looked upon as matter valueless to his hand. We may even go further and say that were it true that the Supreme Intelligence *had* created the material universe, and by special providence modified or thwarted the general laws through which that universe was governed,—such Divine supervision, and such miraculous interposition must necessarily have been ignored.

Let it not be inferred, however, that each and all of the great men who have been engaged in this work of scientific reformation were necessarily driven to be impious iconoclasts, or that in their efforts to emancipate themselves from time-honored errors, they necessarily prostituted the liberty they gained to selfish or sensual purposes. On the contrary, the most important advances which the human intellect has made within these later centuries have been due to the efforts of men of the purest and most conscientious character; men whose lives were devoted with the utmost singleness of purpose to determine *what is truth;* men who, knowing that all truth must be consistent with all other truth, were willing to go whithersoever it should lead. If it shall prove that they have been occupied with "mint, anise, and cumin," omitting the "weightier matters of the law," it is also true that in no other way could the material laws of the universe be thoroughly investigated than by making them the subjects of an absorbed and undivided attention. And it is not true, in any sense, that these devotees of science have lived in vain; for to them we mainly owe the fact, that man is not only wiser now than formerly, but that he is better and happier. It would be as just to impugn

the motives and decry the merits of the maker of our almanacs because his mathematical calculations were not interlarded with moral maxims, as to reproach the student of natural phenomena because he did his work so well, and left to others the coördination of the results of his efforts with the accepted dogmas of religious faith.

In justice to the man of science we must go still farther than this, and claim for him the position of co-laborer with, and indispensable ally to the philanthropists and moralists: for from no source have they drawn richer lessons, stronger arguments, or more eloquent illustrations than from his discoveries.

And yet while conceding conscientiousness and purity of motive to the vast majority of our men of science, and acknowledging the contributions they have made, and are making to human happiness; compelled by my sense of justice to defend their spirit, approve their methods, admire their devotion, and assert their usefulness, I cannot deny that the tendency of modern investigation is decidedly materialistic. All natural phenomena being ascribed to material and tangible causes, the search for and analysis of these causes have begotten a restless activity and an indomitable energy which will leave no stone unturned for the attainment of their object. But while this is apparent, and, indeed, inevitable, as has been seen from the sketch of the growth of modern science, I am far from sharing the alarm which it excites in the minds of many good men. Nor would I encourage or excuse that spirit of conservatism—to call it by no harsher term—which for the safety of a popular creed, would by any and all means repress, and, if possible, arrest investigations that may possibly become revolutionary and dangerous.

Such opposition, in the first place, must be fruitless. All history has proved that persecution by physical coercion or obloquy is powerless to arrest the progress of ideas, or quench the enthusiasm of the devotees of a cause approved by their moral sense. The problems before our men of science *must* be solved in the manner proposed, if human wisdom will suffice for the task. In every department of science are men actuated simply by a thirst for truth, whom neither heat nor cold, privation nor opposition will hold back from their self-appointed tasks. We may, therefore, accept it as a finality, that this problem will be carried to its logical conclusion.

In the second place, if possible, the arrest of scientific investigation would be not only undesirable, but an infinite calamity to our race. As has been so often said, truth is consistent with itself. If, therefore, our faith in this or that is based on truth, we have no cause for fear that this truth will be proved untrue by other truths. And more than this: it seems to me, that, in the reach and thoroughness of this material investigation, we may hope for such demonstration of the reality of things immaterial as shall produce a deeper and more universal *faith* than has ever yet prevailed.

Through this very spirit of scepticism which pervades the modern sciences we are compelled to exhaust all material means before we can have recourse to the supernatural. When, however, that is done, and men have tried patiently and laboriously, but in vain, to refer all natural phenomena to material causes, *then*, having proved a negative, they will be compelled to accept the existence of truth not reached by their touchstone, and faith be recognized as the highest and best knowledge.

That such will be the result is the confident expecta-

tion of many of the wisest of the scientific men whose influence is looked upon with such alarm by those who, in their anxiety for their faith, demonstrate its weakness.

Already, as it seems to me, scientists have reached the wall of adamant—the *inscrutable*—that surrounds them on every side, and, erelong, we may expect to see them return to that heap of chaff from which the germs of modern science were winnowed, with the conviction that there were there left buried other germs of other and higher truths than those they gleaned; truths without which human knowledge must be a dwarfed and deformed thing.

A few illustrations from the many that might be cited will suffice to show the materialistic tendency of modern science. In "Pure Philosophy,"—as the students of Psychology are fond of styling their science,—the names alone of Compte, Buckle, Herbert Spencer, Mill, and Draper will suggest the more prominent characters of the school they may be said to represent. The most conspicuous feature in the "Positive Philosophy" of Compte is the effort it exhibits to coördinate the laws of mind with those of matter. Spencer is a thorough-going mental Darwinist, who considers the highest attributes of the human mind, the loftiest aspirations of the soul, as only developed instincts, as these were but developed sensations. Mill, more guarded, more fully inspired with the spirit of the age,—which *believes* nothing, and is a foe to speculation,—leaves the *history* of our faculties to be written, if at all, by others; takes them as they are, but reasons of conscience and free-will with an independence of popular belief that savors more of the material than the spiritual school. Buckle wore himself out in a vain chase

after an *ignis fatuus*, an inherent, inflexible law of human progress, and hence of human history. Draper is a developmentist, but not a Darwinian. With him civilization is a definite stage in the growth of mind; a degree of development to which it is impelled by a *vis a tergo*, not unlike, in kind, to that which evolves from the germ, the bud, the leaf, the flower, and the fruit in plant-life,—a development which, when unchecked and free, will be regular and inevitable, but which is so modified by the accidents of race, climate, soil, geographical position, etc., as to render it difficult to say whether the rule or the exception has, in his judgment, greatest potency. If he were a consistent Darwinist, the accidents of development would be its law.

Among the students of "Social Science,"—a new and important member of the sisterhood of sciences,—as in most of the other departments of modern investigation, two groups of devotees are found; one patiently and conscientiously studying the problems of social organization, inspired with the true spirit of the Baconian Philosophy, ready to follow whithersoever the facts shall lead, and having for their object that noblest of all objects, the increase of human happiness. The other class of investigators, in whom the bump of destructiveness is largely developed, would be delighted to tear down the whole fabric of society, and abrogate all laws, both human and divine. Looking upon man as literally the creature of circumstances, as an inert atom driven about by material forces, conscience and responsibility are by them repudiated, and laws and penalties regarded simply as relics of barbaric despotism. The dreary soul-killing creed of these fatalists is fortunately so repugnant to the reason and feelings of the majority of men, that there is little

danger that their efforts will reach their legitimate conclusion in throwing society into a state of anarchy and chaos.

In Theology or Biblical Science the tendency of modern investigation is so distinctly felt, that I need only refer to it. The spirit of independent criticism, so noticeable elsewhere, is still more conspicuous here; assuming sometimes the form of derisive scepticism, but oftener of cold, passionless judgment on the reported facts of sacred history, or the psychological phenomena of religious faith, studied simply as scientific problems.

The names of Strauss, Renan, and Colenso, will suggest the results to which men, possibly honest, are led by this so-styled "enlightened and emancipated spirit of enquiry"; while "Ecce Homo" and cognate productions may be considered as the fruit of this spirit, tempered by a very liberal but apparently sincere faith.

Aside from these more marked examples of the decided "set" in the tide of modern religious opinions, we everywhere see evidences that no part of the religious world is unmoved by it. In every sect and section an impulse is felt to substitute for abstract faith, the "faith without works," rather a characteristic of the religion of our fathers, and not unknown at present—that other faith which is evidenced *by* works. In other words; in our day more and more value is being attached to *this life*, as a sphere for religious effort and experience. With what propriety, I leave to the individual judgment of my auditors; the faith of every sect and man is coming to be respected and valued precisely in the ratio of the purity, unselfishness, and active sympathy in the life produced by it.

While, therefore, we have less now than formerly of

the self-centred and fruitless piety of the old deacon whom I chanced to know, who excused his avarice by proclaiming that "business was one thing and religion another, and he never allowed them to interfere"; in place of that we have many an Abou Ben Adhem, and all the splendid exhibitions of modern philanthropy.

Though the golden mean displayed in the life and words of Christ is far better than either extreme, I cannot but think the present religious condition of the world is better than any which has preceded it.

So far as regards the *facts* of sacred history, it is well known that modern antiquarian researches, especially those of Leyard, Rawlinson, and Hinks, among the Assyrian inscriptions; of Champollian and Lepsius, in Egypt, have confirmed in a remarkable manner the accuracy of the historical books of the Bible.

In Ethnology—the pre-historic history of the human race—the researches of the large number of investigators who are devoted to its study have made interesting and important additions to our knowledge; but it cannot be denied that the result of such investigation has been to create general distrust of our previously accepted chronology, and give an antiquity to man such as the scholars of a previous generation would have looked upon as not only unwarranted but impious. It should be said, however, that our preconceived opinions of the antiquity of the human race—like those of the age of the earth itself—were based upon no solid foundation in nature, history, or revelation; and that our system of chronology was a matter of convention, about which there has been a wide latitude of opinion among the scholars of all ages.

In regard to the *origin* of man—whether by special creation or by development—we may confidently assert,

that modern investigation has given us no new light. Among those who have accepted the theory of a special creation, and have differed only in regard to the number of species and their places of origin or centres of creation, there has been such a diversity of opinion that all confidence in their reality and value of the bases of their reasoning has been lost. Among the advocates of a multiplicity of species and diversity of origin we have from Blumenbach to Agassiz almost every number between fifteen and three as that of distinct species of the human race, scarcely any two writers advocating the same number. We may, therefore, very fairly infer that the facts upon which their conclusions are founded, are not of a very clear and unmistakable character.

The subject of the origin of the human race brings us into the domain of zoölogy, and opens the wide question of the origin of species, which, of late years, has been shaking the moral and intellectual world as by an earthquake. While the various writers upon the origin of the human race were gathering with so much industry, and reporting with so much eloquence the proofs of a diversity of origin, the Darwinian hypothesis comes in and refers, not only all the human family, but all classes of animals and plants, to an initial point in a nucleated cell.

It would be impossible for any one to discuss, in a fair and intelligent manner, the great question of the origin of species, in anything less than a bulky volume. The merest mention is, therefore, all we can give to it at the present time. Although the appearance of Darwin's book on the Origin of Species communicated a distinct shock to the prevalent creeds, both religious and scientific, the hypothesis which it suggests, though now for

the first time distinctly formularized, was by no means new; as it enters largely into the less clearly stated development theories of Oken, Lamarck, De Maillet, and the author of the "Vestiges of Creation." There was this difference, however, that in the developmental theories of the older writers the element of *evolution* had a place; the process of development had its main spring in an inherent growth, or tendency, such as produces the evolution of the successive parts in plant-life, while, according to Darwin, the beautiful symmetry and adaptation which we see in nature is simply the form assumed by plastic matter in the mold of external circumstances.

Although this Darwinian hypothesis is looked upon by many as striking at the root of all vital faith, and is the *bête noire* of all those good men who deplore and condemn the materialistic tendency of modern science, still the purity of life of the author of the "Origin of Species," his enthusiastic devotion to the study of truth, the industry and acumen which have marked his researches, the candor and caution with which his suggestions have been made, all combine to render the obloquy and scorn with which they have been received in many quarters peculiarly unjust and in bad taste. It should also be said of Mr. Darwin, that his views on the origin of species are not inconsistent with his own acceptance of the doctrine of Revelation; and that many of our best men of science look upon his theory as not incompatible with the religious faith which is the guide of their lives, and their hope for the future. To these men it seems presumption that any mere man should restrict the Deity in his manner of vitalizing and beautifying the earth. To them it is a proof of higher wisdom and greater power in the Creator that he should endow the vital principle with such

potency that, pervaded by it, all the economy of nature, in both the animal and vegetable worlds, should be so nicely self-adjusting that, like a perfect machine from the hands of a master maker, it requires no constant tinkering to preserve the constancy and regularity of its movements.

This much I have said in view of the possible acceptance of the Darwinian theory by the scientific world. I should have said, *in limine*, however, that the Darwinian hypothesis is not accepted and can never be fully accepted by the student of science who is inspired with the spirit of the age. From the nature of things it can be proved only to a certain point, and while we accept that which is proven,—and for it sincerely thank Mr. Darwin,—that which is hypothesis, or based only upon probabilities we reject, as belonging in the category of mere theories, to disprove or purify which the modern scientific reform was inaugurated. Much, too, may be said against the sufficiency of "natural selection in the struggle of life," from observations made upon the phenomena of the economy of nature. Necessarily, the action of the Darwinian principle must be limited to the individual, literally and purely selfish; and if it can be proved that a broader influence pervades the created world, that something akin to benevolence enters into the organization of the individual, something which benefits others and not himself, one single fact establishing this truth would hurl the entire Darwinian fabric to the ground, or rather restrict it to its proper bearing upon the limits of variation, and the mooted question of "what is a species." One of the most potent influences in the perpetuation of species is fecundity in the individual, whereas we see in social insects the economy of the community is best served by a total

loss of this power in the great majority of the individuals which compose it. This objection will perhaps be met by the Darwinians with the assertion that the community, in fact, constitutes an individual; but I must confess that I find it difficult to comprehend how the sterility of the workers in ants and bees was ever introduced through the medium of modified descent, the Darwinian method, or how it is kept up from generation to generation among those individuals who have no posterity to inherit their peculiarities of structure.

The Honey Ants of Mexico offer additional difficulties. Among them a portion of the community secrete honey in the abdominal cavity until they resemble small grapes, and these individuals, during the winter, are dispatched in succession to furnish food for the other members of the colony. How, by modified descent, is this honey-making faculty transmitted, when those who possess it are systematically destroyed?

A still harder nut for the Darwinians to crack is furnished in a fact stated by Dr. Stimpson, that among the crustacea, which do not live in communities, a very large proportion of the individuals of a numerically powerful species pass their lives as neuters, or undeveloped females.

Another element in nature's economy, which at first sight suggests an objection to the Darwinian theory, is that of *beauty*, which affects others far more than the possessor. This is considered by the Darwinians simply as an attraction to the opposite sex, but as a fact we find that in the larval condition of some insects—a condition in which no propagation is effected—varieties of form and combinations of color exist which appeal to our sense of beauty scarcely less forcibly than in the perfect insects.

Again, the origin of life is left completely untouched

by the Darwinian hypothesis, ánd so long as the vital principle resists, as it has done, all efforts of theorists and experimenters to bring it within the category of material forces, so long we must regard the world of life as including elements not amenable to the laws which control simple inert matter.

Upon this question of the origin of life so much is being done and said that you will expect a word of reference to it at my hands, yet little more can be reported as the result of all modern research than that the origin of life is as great a mystery as ever. You will all remember how, a few years since, we were startled by the announcement of the discovery of the generation of the *Acarus Crossii;* and, while our original distrust of the accuracy of the observations of Mr. Cross was strengthened by the failure of all subsequent experimenters to reproduce his results, our unbelief is further confirmed by the unanimity of all the more modern and intelligent devotees of spontaneous generation in the assertion that life can only originate in its simplest form, that of a unicellular organism. There is no Darwinist who will concede the possibility of an animal as highly organized as an *Acarus*, with body, head, limbs, digestion, and senses, all more or less complete, being the product of spontaneous generation and not the result of slow and gradual development.

Still farther; it is known that the animal kingdom rests upon the vegetable as a base. Animals being incapable of assimilating inorganic matter could not exist without plants. Plants must therefore have preceded animals, and the fruit of spontaneous generation must be a protophyte and not a protozoan.

As I have said, the materialists have so far utterly failed to coördinate the vital force with those which we

designate as material. The beautiful and important discoveries which have followed researches into the correlation and conservation of forces by pointing to a unity of all the forces in the material world have naturally prompted efforts to centralize, with electricity, magnetism, and chemical affinity, that which we know as vital force. But a moment's reflection will show us how far removed is this vital force from all others with which it has been compared.

The nicest manipulations of chemical science will probably fail to detect a difference in composition between the microscopic germs of two cryptogamous plants. Each consists of the same elements, carbon, nitrogen, hydrogen, and oxygen, in nearly or quite the same proportions. Both may be planted in a soil which laborious mixture has rendered homogeneous, and subsequently supplied with the same pabulum, and yet, in virtue of some inscrutable, inherent principle, one develops a humble moss, and the other rises into the beauty, symmetry, and even grandeur of a tree fern. The same may be said of the spermatozoa of the mouse and the elephant. Indeed all the phenomena which attend the reproduction of species are totally at variance and incompatible with those which mark the action of material laws. Why, in physical circumstances differing *toto cœlo*, does the germ produce a plant or animal so closely copying the parent? and whence this tenacity of purpose in the germ which reproduces, through a long line of posterity, the trivial characteristics of a remote ancestor. Even within our limited observation we have been struck by the reappearance in the grandchild of the voice, the gesture, the stature, the features, or some other marked peculiarity of his grandsire. Whence comes the force of the axiom that "blood will

tell" ?—and how incomprehensible that, by the action of only material laws, mental force, or, it may be, moral infirmity is transmitted from generation to generation, in spite of the system of infinitesimal dilution through which it passes!

Strange as it may seem, there are to-day men, respectable by their numbers and attainments, who are believers in spontaneous generation; but with this proviso which leaves the mystery as great as ever, that only from *organic* matter can organisms be produced. So that to the original and primary appearance of life upon the earth, modern science has given us not the slightest clue.

And now, even with this hurried and sadly imperfect exposition of the tendency of modern science, the time at our command has been consumed. Before leaving the subject, however, I crave your indulgence for a word to those who, wholly absorbed in the study of the laws which regulate the material universe, are so deeply impressed with their universality and potency, that they forget that law is but another name for an order of sequence, and has in itself no force. These are they who, in their pride in the achievements of the human intellect, fail to realize that the universe furnishes conclusive proof that all our philosophy, all our logic, all our observation are utterly inadequate to solve the problems that are presented to us; inadequate not simply from the limited nature of our powers of observation, but because the human mind, though forced to confess the existence of the infinite, is utterly unable to grasp it; and that while the logic of reason and the logic of numbers suffice for a qualified understanding of the manner in which material forces work, of the origin and nature of these forces we are and must ever remain ignorant, unless gifted with higher

powers than we now possess. As has been stated, seen from the stand-point of our modern materialists, and judged by the criteria which they have adopted, spiritual existence and supernatural phenomena, even if as all-pervading as the most devout religionist believes, must, from *a priori* considerations, be utterly ignored. Of those whose regard for the dignity of material laws leads them to reject the idea of a creative and overruling Deity, I would ask, Is not man himself a disturbing element in your universe? Whatever may be said in regard to man's free-agency, and however confidently it may be asserted that his will is but the resultant of the various motives that operate as distinct forces upon it, consciousness lies at the bases of all reasoning; and the conduct of every man proves that he accepts this axiom. As he issues from his door he is conscious, beyond all argument, that it is in his power to turn to the right or to the left; and while he holds himself responsible for his volition, he cannot blame us if we ascribe to him free-agency. Man is therefore an independent power in the universe. He wills and creates. The locomotive is as truly his creation, as himself fashioned from the dust of the earth and vitalized by the breath of the Almighty, is the work of his hands. If, therefore, all the realm of nature is controlled through material laws, by forces that, like attraction, electricity, chemical affinity, etc., act in an invariable and inflexible way, in this universe man is a stupendous anomaly; and unless he can be degraded from his position of preëminence in this material world, the boldest and most irreverant of modern philosophers will strive in vain to dethrone the great Creator from the rule of the universe, or from his place in the hearts and minds of men.

THE ROYAL FAMILIES OF PLANTS.

No. II.

BY C. M. TRACY.

The second of the royal lines in the vegetable world affords a view greatly different from the first. That, it will be remembered, consisted of the composite flowers, or the Family of the *Asterids*. Now we will contemplate for a while the family of the second degree of botanical importance. It is familiarly known to us in the Pea and Bean. It has long been called by students the *Leguminosæ;* that is, the Leguminous Plants, or those bearing a legume, or simple pod, for a fruit. Lindley thought proper, in arranging the "Vegetable Kingdom," to call this family the *Fabaceæ*, from *faba*, a bean; but if the reader please, we will employ a title for them here shorter and more convenient, and derived from the group that best typifies the family, which the bean does not. We will term them the *Pisids*, from *pisum*, or the Pea.

The royalty of these *Pisids* is quite different from that of the *Asterids*. Those challenge admiration by their vast numbers and universal presence; but these more by their peculiar nobility of style, whether as to beauty or grandeur. Not that these are much inferior, numerically; for, in the best enumerations of the day, six thousand five hundred species are reckoned, arranged in four hundred and sixty-seven separate groups or genera. We have no calculations made so recently as to warrant our stating very exactly the geographical distribution of these species in various regions. They are not, however, greatly disposed to stray about and play the emigrant over the world's broad acres; but are rather remarkable for sitting down quietly at home, and enjoying their separate dig-

nities in their original possessions, as self-satisfied as the old grandees of Spain. Thus there are species in Australia that no other country can furnish; for they have never travelled from the island yet, whatever they may be tempted to do hereafter. So with those found at the Cape of Good Hope; and even of the European genera there are some that never have penetrated into either Asia or Africa more than a very little way. Yet, in one form or another, they are met with almost everywhere; in fact, we hear only of two spots entirely without them, namely, the islands of St. Helena and Tristan d'Acunha; and perhaps it detracts nothing from the royal wisdom of these plants that they have kept themselves clear of two such Heaven-forsaken places.

Before, however, proceeding too warmly into the admiration of this grand order, we should give the reader some simple means of recognizing it when he meets it. In these familiar views of natural families, we like to bring luminously before the eye of the untechnical lover of plants the few constant marks that we hold to exist in every such family *somewhere*, as the true key to all their mutual relationships, and the fit signs by which they may be readily and definitely known. Now, as we had three marks whereby certainly to know an *Asterid*, so we have three that as certainly indicate a *Pisid;* but whereas in the other case all three are always present, here one may be absent, but never two, and one never disappears at all.

Get the first pea, bean, or locust flower you see. A large flower is easier to study than a small one, and these are the largest we have. The Sweet Pea is, perhaps, best of all, but the bean-flower has some obscurities to the common eye. Turn the flower face to face with you.

All flowers, or at least the great majority, are made up of five leaves or petals; and so is this, if you will believe it. But you can hardly see any such structure; it merely looks like a miniature lady's head in a high-front bonnet of the year 1838. Or perhaps it suggests the idea to you that it has to scores of others, who for years have likened such flowers to butterflies. Hence these plants are often called *Papilionaceous*, from *papilio*, a butterfly. Such notions are all fanciful; but the structure of these flowers is quite decisive. As you now hold it, the large, showy top leaf or petal is one only, and, we might say, about as large as it should be. Below it, right and left, are two more, mated like your gloves; these have been called the *wings*. They are considerably reduced, usually paler, and sometimes of a very different color from the large one above, which we may call the *banner*. This makes three petals. Next, between the wings, wrapped up in them closely in some cases, is what does not look much like a petal or leaf of any sort; but is really the fourth and fifth, very little developed, and grown together by the edges. They make what has always been called the *keel*. This is the structure of the Pea-flower the world over. It never appears outside of the Royal Family of *Pisids*, and it is present there in a vast majority of cases. It is one of the three badges of their regal character.

Next, take a pea or bean-pod, just fit to shell. It is one-sided in its form; that is, the point farthest from the stem is on one side more than the other, so that of the two seams at the edges of the pod one is nearly straight, and one very much rounded. Now split this pod cautiously along the *straight* side. The seeds lie within, and if you have done the thing nicely, you have laid the pod open flat, with each half claiming the alternate seeds, so

that in a well-filled pod of peas, about four are found growing on one side, and as many on the other. This is the structure of the *legume*, or simple pod. Possibly it appears, in some instances, outside the royal family; but very rarely, indeed, if ever. It is not like the pods of the Mustard and Gilliflower, for they have a partition running through them flatwise, and the seeds hang upon both seams instead of one. The pods of the Milkweeds are very different, again, being mere bags in which the seeds are enclosed without the least attachment to any part, but grow upon the end of the stem where it passes into the interior. The simple pod, or *legume*, then, is the second mark of the *Pisids*, and any one can tell it at a glance.

The third mark is simple, curious, and infallible, to the highest degree. The family most likely to be confounded with these is that to which the Rose and the Apple belong; in fact, though we might not expect it, the two run so closely together, that only this third mark is decisive as between them. And yet, all-important as it is, it seems the merest trifle. Look at the bottom of the Pea-flower, outside. There are five small, green, pointed leaves surrounding it, that together are called the calyx, and severally are termed sepals. Now find a flower that grows pretty low down on the stem,—from the angle of a leaf perhaps,—and carefully lift it up against the stem without giving it any twist one way or the other. Thus you bring the real top of the flower to the stem. Notice, now, that if you have worked fairly the stem comes, not against one of the green sepals, but into the notch or space between the upper two of them. The odd sepal, so to speak, is on the outer or lower side. If we had taken a rose or an apple-blossom or the flower of a Spiræa, and so examined it, we should have met just the reverse; the

odd sepal will always be found at top, or next the stem. The invariability of these facts is really wonderful. It is one of those great little things whose discovery sheds such lustre on the genius of Robert Brown, the man whose eye pierced more keenly through the vegetable millstone, than any other man's before or since his time.

Recapitulate then. The marks of the *Pisids* are,—

1. Butterfly, or better, pea-flowers.
2. Legumes, or simple pods, for fruit.
3. The odd sepal turned *away* from the stem.

True, these are not all the marks that are useful in distinguishing this family. But they are the most simple and certain at once. Almost all have compound leaves, such as are found on the Locust, Clover, and Acacia. But we cannot be entirely safe in depending on this; for, not to speak of exotics, the Woodwaxen contradicts the point at our very door. But the Woodwaxen has the three great marks all very plainly, and therefore is a true Pisid, belonging clearly to the royal line, hate it as we will.

In this great family there are three sets, or, as we might say, cousinships. They are each marked by some distinctive properties, and each varies in certain degrees and manners from the typical structure which belongs to all.

First. We have a set with perfect pea-flowers and mostly true pods; but in some, as the Tonka-bean, and the Ground-plum of the West, the pod grows thick and fleshy, and closely resembles a drupe, or stone-fruit of some sort. In this tribe we meet with nearly all the species that afford valuable food to man or beast. We hardly need to cite examples.

Second. We find a set with flowers quite indefinite in

form; some nearly perfect by the type, and others almost as regularly five-petalled and circular as an apple-bloom. But here the pod keeps as close to the normal style as the flower departs, so that we never lose our guide. In this set are the chief medicines and drugs that the family produces. We see examples of this tribe in the Wild Senna and Honey Locust.

Third. A set remains in which the pea-shape is wholly obsolete, the flowers being as completely regular as any to be found. The pods, however, so far as we are informed, preserve the simple form, and our marks are fully vindicated. We have no indigenous plant that belongs here; the greenhouse Acacias are those most familiar. The peculiar properties appear in the abundant production of gum and tannin.

Like princes true, these plants take up nearly every variety of stature, habit, and soil. In regard to size, their range is perfectly enormous. In the gardens are species of Lotus that the gardener loves, and species of Medicago that he hates for the wretched weeds that they are, and neither of them is an inch high, but they creep on the earth like a carpet. There are perfect plants of the Pussy Clover that will go into an ounce vial with little crowding. Then, *per contra*, take the great Locusts of Brazil, described by Von Martius. Fifteen Indians, with outstretched arms, could just encircle the base of one of them. Some were measured and gave eighty-four feet in girth at the ground, and sixty feet where they first became cylindrical in form. This reliable observer made careful calculations on the age of these trees, and carried it back, in some cases, to the time of Homer, and, by all probability, beyond the Christian Era. The style and habit of these plants vary quite as much. The Honey

Locust, especially where at all stunted or neglected, is a tree that a cat can hardly climb, bristling and horrid, a perfect *chevaux-de-frise* of thorns; and the Hog Peanut glides over and round the bushes, where it climbs with a stem hardly strong enough to bear its own foliage, a half invisible thread of green. The Bauhinias bind themselves round the great South American trees like ropes of wire; the Wistarias climb and revel in the Chinese thickets like grape-vines; while the Sensitive Briar creeps timidly among the herbage of the Carolinas, and the graceful little Tare intrudes in northern fields, presuming on its good looks for a chance of renewed impertinence. They are hardly as partial to maritime situations, yet the Beach Pea loves no place so well as its "home by the deep, deep sea," and the Wild Bean equally delights to hang its wanton herbage over bluffs where it can hear the scream of gulls, and see the fisherman casting his lines, hardly more twisted than its own.

As hinted already, the nobility is very different from that of the *Asterids*. That family surprises us by its inutility; this overwhelms us by its wonderful wealth. There is hardly a thing of any use to man that is not, somewhere or other, produced by this family. The other was the royalty of blood and self-complacency; this is that of profusion, extravagance, abundance without limit or stint. We are not writing a volume, and so will not try any enumeration of the thousand products here to be found; but do we desire fine timber? We may take our choice of Rosewood, West India Locust, Itaka-wood, Purple-heart, Acacia-wood, Mora-wood, and a score of others, not forgetting our own Locust, whose fibre defies almost every destroying agent but the borer.

Or would we prefer dyes? Logwood and Indigo, Gum

Lac and Dragon's Blood come at call, with Brazil-wood, Brasiletto, Camwood, Sappan-wood, and Red-sanders. Besides, in India, there are fine yellow dyes from several Buteas, and in Japan from a large tree (nameless to us), while we may have almost as good from the Woodwaxen. If we seek perfumes we shall not go far astray. Tonka-beans, Lign-aloes, Calambac, Balsam of Peru, Balsam Tolu, and Acacia-flowers, are ready representatives in this department. The tanner needs little help from any other tribe if he only have this. The Acacias, Bauhinias, and Cassias give their bark, and Prosopis its pods for his purpose, and they fairly dispute precedence with the Oak and Sumach. In gums they rule the world. Gum Arabic, Tragacanth, Senegal, Animi, Brazilian Copal, and Kino attest this. And yet in drugs their precedence is greater still. Liquorice comes here, with Manna, Senna, Cowhage, Fenugreek, Copaiva, and Catechu, and perhaps a hundred more might be added. If we like to study poisons, we might get a large selection of specimens here; in fact, there is a suspicious character, a kind of royal treachery, underlying the whole group. The beautiful scarlet seeds sold in the shops for beads, and called by the children "Black-eyed Susans," are reported as highly poisonous; certain wild plants of this family once killed whole flocks of sheep in the Swan River Colony; and others are common fish-poisons in Jamaica. Indigo is by some pronounced to be deadly, but others dispute the point seriously. There are not, perhaps, many of these hurtful products that appear as known drugs, but they are none the less present. The seeds of various Sweet Peas have been used in Europe during famine, with such evil effect that they had to be interdicted by government. The Coronillas, common in gar-

dens, are likewise condemned; and the seeds of the Laburnum have done serious mischief.

But despite some poisonous and hurtful tendencies, there is a noble excellence in the royal race. They furnish food unmeasured to thousands of hungry dependents. We may begin with the Peanut, indispensable everywhere, from the Yankee town-meeting hall and circus, to the negro-huts of Senegambia. The quantity of these consumed for food the world over is probably far greater than generally supposed. As to Peas and Beans, not only does the soldier of the Rebellion fully know their value, and every New Englander who loves his Sunday breakfast bear witness, but the world admits it all since the time when Daniel and his three friends grew fatter upon pulse than on the King's meat. The sacred writer does not say they changed their diet from the "King's meat" to the very flesh of royalty, but so it really was. The Tamarind is the cheerful friend of the convalescent, and Shenstone says of a drink skilfully made from it,—

"Whoso drank the cooling draught
Would never wish for wine."

There are several sorts, produced by related plants, and known as Brown Tamarinds, Velvet Tamarinds, and Tamarind Plums, all highly prized. The Carob-tree has a pod in which the seeds are buried in a dry, mealy pulp, very nutritious, and eaten freely by horses in Spain and the Levant. It is supposed to be the tree which furnished the "locusts," or locust-pods, that fed John the Baptist in the wilderness. The West India Locust affords something very similar, and as readily eaten. The Parkia, an African tree, furnishes seeds of which the natives make a sauce for meat, in cakes like chocolate, eating also the pulp found in the pods. The famous drink of Central

America, the Chica, deserves mention, as prepared from the sweet pods of a Prosopis; but the manner of making it is such as would forever sicken any one not well hardened in savage life.

Of course these are not all the points of wealth in this noble family. Their treasury never is bankrupt. The Bauhinias have tough bark that makes good ropes. We have in New England a plant called Rattle-pod; and another of this same genus in India produces the Bengal Hemp, very useful for cheap bagging. Some are effectual to destroy vermin, and others yield a juice much employed in the manufacture of Indigo in certain parts of the process.

The beasts fare no worse than their human guardians. At the head of the list stands Clover, so acceptable in its green state to the horse, that it is said that he will eat it till he bursts. Closely related to this are the various species of Lucern and Medick, and sundry Trefoils, all sweet and nourishing to every flock and herd. Saintfoin and Serradilla stand in the same line of usefulness. In the arid deserts of the East grows a stunted bush, the tender character of whose herbage has, in those wastes, earned it the name of the Camel's Thorn. Among the Afghans this plant is depended on above all others for the support of cattle, and if the supply is cut off by war at any time, the herds suffer or perish. So the Woodwaxen is eaten well by sheep, it is said; and many farms, we learn, are pastured in the British Islands at good rates, though they produce little save the prickly "Whin."

Nor would the kingly rank be well sustained by the *Pisids* if they could not boast of beauty; but in this there is no more lack than in other respects. The most splendidly beautiful tree in the world, when in flower, is said

to be the *Amherstia nobilis*, a grand ornament of the Turkish gardens. There also the Cercis, or Judas-tree, lifts its head in purple magnificence; while its plainer, but still charming co-species, the Red-bud of the Canadas and Northern States, is glowing through the woods in the pride of its early bloom. All New Holland is golden with a wealth of Acacia-flowers; and other species, with red instead of yellow, put the most charming blush on the forest-cheek of Mexico. Europe is rich in fine Laburnums; and South America is all aglow with splendid Ingas and Mimosas. The Californian has brought from New Zealand the Glory-pea, and given it a home by his own door, that suits as well as its own. Our own country is full of beautiful plants of this kind; Lupines and Locusts, Hoary Peas, Wistarias and Prairie Clovers, Tick-trefoils and Yellow-wood, Partridge-peas and Ground-plums, all showy and lovely. And whosoever will penetrate the conservatory, and study the floral wealth there displayed by these pea-flowered princes, will find these thoughts well sustained and illustrated.

And yet we have only just come to the most interesting trait in the character of these most royal plants. In them does vegetable life reach its acme, and attain a grade that lacks but the merest step to equal the vitality of animals. The Joint-vetch, of the Virginian river-banks, is sometimes sensitive, and shrinks from the touch, closing its leaflets. Another step, and we have the Sensitive Briar, common through the South, and showing this sensibility in a much higher degree. Then going to Central and South America, we have Mimosas endowed with every degree of this power, till some will hardly bear the human breath upon them, even though they may bear the beating of wind and weather. Great numbers of *Pisids*

keep careful watch of storm and sunshine, however, as well as of day and night, and close their leaves promptly when unfavorable conditions arise. This is but a small matter; other plants do the same; but no other tribe shows such tenderness of feeling in the foliage. Nor do they stop here. In the East Indies grows the strange plant, *Desmodium gyrans*. It may be compared, perhaps, in appearance, to our Wild Indigo, but its leaves are more like those of the Rose. The leaflet at the end only folds up at night and opens by day; but the side-leaflets are always moving, the two sides alternately up and down with a jerking motion, as one says, like the second-hand of a watch. The touch arrests it, or so does cold or narcotics. But left to itself it soon begins again.

Now this, seeing there are here no bones, joints, muscles, or other machinery to execute such movements, is a most astonishing thing. Nearest of anything the world affords does it come to showing the Abstract Life working independently, without mediate agency, and challenging all our skill to grasp it, or account, in any satisfactory way, for the presence that we so unequivocally recognize. Electrical and chemical action are called to explain it, but they fail. We leave it, as one of Nature's mysteries.

This hasty glance gives but a superficial notion of the real grandeur of this most kingly of these Royal Orders. From these considerations, however, we may probably gain sufficient evidence to prove the great importance of these plants in the economy of nature, as related both to man, to the animal kingdom in general, to the great principles of vitality and development, higher and broader than all. A further illustration of these ideas may be had from the study of the other of these families, which will engage our future attention.

THE HAND AS AN UNRULY MEMBER.

BY BURT G. WILDER, M. D.

[Continued from page 423.]

In the first part of this article, taking for granted that all readers of the Naturalist are aware that the mammals have two pairs of limbs, of which the hinder are generally called legs, while the anterior are either legs or wings or flippers or arms, according to the use their owners make of them, I made the following statements: 1. That, in spite of great differences in appearance and in the movements which they perform, there is a close anatomical resemblance between the human arm and the foreleg of beasts, the wings of birds, the flippers of seals, etc. 2. That there is a similar resemblance between the leg of man and the hinder limbs of animals. All this is now generally admitted, and, however distasteful may be the actual comparison between the limbs of the bear or of the monkey and our own, we cannot help seeing, that when we get upon all-fours like the one, or stand semi-erect like the other, our limbs really occupy partly the same position in regard to our back-bone as do those of the creatures first mentioned: and I might add, that there is a time in the early stages of growth of all vertebrates, when the limbs are just beginning to form, and are mere little fleshy buds or pads projecting from the sides of the body. (Fig. 6, Plate 12.)

This kind of comparison between the fore or hind limbs of different species is called the study of Homologies, and formerly constituted the whole of Comparative Anatomy. But I also stated that within the past century there has arisen a new kind of Comparative Anatomy, which has for its object the comparison, not of corresponding

parts in *different* animals, but of corresponding parts in *one and the same animal;* in short, the human arm is compared, not with the foreleg of a quadruped, but with the human leg: and in like manner the fore and hind legs of a beast are compared with each other.

And, lastly, I stated that it is now pretty well agreed that in this comparison the shoulder and pelvis represent each other; that the humerus and femur are similar parts in the two limbs; that the elbow and the knee, the forearm and the leg do in some way correspond with each other; and that, finally, the foot is, as a whole, the humble representative of the hand. Yet there is a very wide difference of opinion as to whether or not the great toe is the counterpart of the thumb; and this because the rotation which takes place in the forearm allows the thumb to come into two different positions.

If you will take the trouble to place your hand upon the table, the palm downward, and the fingers pointing forward, you will see that the thumb comes upon the *inner* side of the hand, that is, toward the middle line of the body, as does the great toe in the foot; but if you *supinate* the hand and place it on the edge of the table so that the fingers point backwards, the palm facing downward and forward, you will see that the thumb now comes on the outer side of the hand, and is opposite the little toe.

You will say at once and truly, that the former is the easier and more natural position, and coincides more nearly with your previous ideas respecting the thumb and the great toe, and it might perhaps do very well if the hand and the foot were the only parts concerned; but unfortunately the arm and the leg must also be taken into consideration, and whatever principle we adopt for the former, ought to apply equally well to the latter.

Now what idea is suggested when we compare the hand and the foot in the manner first described? The whole foot points forward, and the sole faces downward and backward; the hand and fingers also point forward, and the palm faces downward and backward: at once we say the corresponding parts point in the same direction, they are *parallel* with each other; and if the hand and foot are parallel, why, of course, the other corresponding parts in the two limbs are or ought to be so too.

But here comes the difficulty. The other segments of the limbs are *not* parallel, but the contrary; the thigh points forward, and the upper arm backward; the convexity of the knee looks forward, while the elbow projects backward; the forearm and the leg likewise point, not in the same, but in exactly opposite directions.

The upper parts of the limbs, then, suggest *antagonism* or *oppositeness;* the hand and the foot suggest *parallelism.* Which shall yield to the other? Shall the upper segments of the limbs be so turned or twisted or viewed as to conform to the idea of parallelism, or shall the hand be supinated and the fingers made to point backward so as to be in antagonism with the foot? This, as was said, brings the thumb on the outer side, and so into relation with the little toe. To this, the thumb objects, and the whole controversy rests between those who favor it exclusively, and those who are willing to pay some regard to the other portions of the limbs.

The former lay great stress upon the functional superiority of the thumb, upon its size and strength, and upon its constant usefulness at every age, from infancy to the time when the man has leisure to reflect upon its wonderful powers and the prominent part it takes in all the operations of the hand; and in view of all this, they urge

that the thumb should be allowed to associate in this comparison with the largest and strongest of the foot's fingers, at any sacrifice on the part of the upper and less conspicuously useful segments of the arm. But the latter believe that the above considerations do not apply in this kind of comparison, and offer facts and arguments (which will be given in another place) to show why the thumb should not be the only part thought of in this connection, and even that it ought to content itself with whatever position as regards the toes may be most convenient for the upper portions of the limb which supports it.

The former uphold one organ against many, and might for that reason be styled the aristocratic party, but for the somewhat incongruous fact, that at the present stage of the controversy, they far outnumber the more democratic members of the other party, who believe in more equal rights for all the parts of the limbs.

So more appropriate titles may be derived from the two ideas which we have found to be suggested, as the thumb is or is not the first part considered in comparing the hand with the foot. If it is, then Parallelism is the idea, and its advocates are the Parallelists. If not, then Antagonism is the idea, and its advocates are the Oppositists.

Among the Parallelists the more prominent in this discussion are Vicq d'Azyr, Bourgery, Cuvier, Flourens, Cruveilhier, Turenne, Owen, Maclise, Martins, Huxley, Mivart,* and Cleland;† to which list might be added the names of as many more anatomists, who have declared themselves more or less decidedly in favor of one or another of the views advanced by those whose names are given.

Those who have more or less completely adopted the

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*Anatomy of Echidna Hystrix. Transactions of Linnæan Society, Vol. XXV. p. 400.

†Quain's Anatomy. Seventh Edition, 1866. pp. 115–117.

idea of Antagonism are Oken,* Gerdy, Agassiz,† Humphrey, Wyman,‡ Foltz,§ and Dana,* with which small number the writer has the honor to be associated.

THE PARALLELISTS. The ancient anatomists contented themselves with pointing out certain obvious correspondences as to general appearance, as those between the bone of the upper arm and that of the thigh, between the knee and the elbow. Their prudent example is still followed by those who do not care to involve themselves in a controversy, and who find it easier to adopt, unquestioned, the opinions of a predecessor; and, in spite of errors and inconsistencies, this method had generally the merit of non-interference with Nature, and may, in medical language, be styled the *expectant* plan of treatment. But a large and distinguished majority of investigators seem to have made up their minds beforehand that something was out of the way, and, in their endeavors to rectify the supposed disordered state of the limbs, have pursued a more heroic course of treatment which, from the various methods employed, may be divided into *dislocation* and *reversion*, *fracture* and *torsion;* or, as their advocates might say, since in their opinion the Creator had already inflicted the above-named injuries upon their unhappy patients, *reduction*, *setting*, and *untwisting*.

Dislocation with reversion and substitution. The first to "resolutely undertake and seriously discuss the problem of the comparison between the extremities in man and

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*The positions of Oken and of Dana upon this question are peculiar, and will be explained farther on.

† Agassiz and Gould's Principles of Zoölogy. 1848. p. 65.

‡ On anterior and posterior symmetry in the limbs of animals. Proceedings Boston Society of Natural History. June 6, 1860; and June 5, 1867.

§ Homologie des Membres pelviens et thoraciques de l'homme. Journal de la Physiologie. Tome VI. pp. 49–81, and 379–421. April, 1863. The works of all the other authors are cited by Mivart, as in the work already cited, p. 395, and by Martins, Nouvelle Comparison des Membres pelviens et thoracique, etc. Mems. de l'Acad. des Sciences de Montpelier. Tom. III. p. 473.

animals," was Felix Vicq d'Azyr, who published a memoir upon the subject in 1774, four years prior to his election as the successor of Buffon, in the French Academy.

He began his comparison by detaching the right arm (Fig. 2) from the shoulder, and placing it by the side of the leg (Fig. 1). He does not specify the position of the hand in this first comparison, but we must conclude that it was *pronated* so as to face the palm backward like the sole, and to bring the thumb (Po) upon the inner side opposite the great toe, both because this was the universal method of viewing them, and because otherwise the idea of parallelism would hardly have suggested itself at all.

Perceiving the resemblance of the elbow (O) to the knee (Pa), and thinking that, being similar parts, they must face in the same direction, he turned the arm around so that the elbow pointed forward, the hand being left as it was (Fig. 3); the two bones of the forearm (U and R), before crossed, became parallel with each other, the thumb, of course, remaining opposite the great toe.

But although the lower portions of the two limbs were thus in harmonious agreement, the anatomist, on examining their upper ends, perceived that, while the smooth articular surface (Fig. 1, Hd) of the thigh-bone was looking *inward* and toward the middle line of the body, the corresponding surface (Fig. 3, Hd) of the humerus, by which it is attached to the shoulder-blade, was looking in exactly the opposite direction.

What was to be done? If he left things as they were, then the heads of the two upper bones set their faces against his idea of parallelism in the most uncompromising manner; while if he restored them to their original condition, the elbow and the knee came into direct oppo-

sition with the idea and with each other at the same time. To avoid both horns of this dilemma seemed at first impossible; but suddenly it occurred to him to drop the unconformable arm, and to try its fellow of the opposite side; and now, upon placing the *left* arm (Fig. 4) by the side of the right leg, and turning it as before so that the elbow pointed forward like the knee, the two bones of the forearm remaining parallel with each other, he was rewarded for his ingenuity by seeing the articular surfaces of the humerus and femur both looking inward. With this very artificial arrangement he seems to have been satisfied, and dismisses the subject with the remark, that "the correspondences of the fingers with the toes are so evident that it is unnecessary to enumerate them"; either not perceiving or caring that though the fingers pointed forward like the toes, yet the thumb was now upon the *outer* border of the limb, and was thus made to correspond with the *little toe*.

We shall, I hope, be convinced that, in spite of the fact that the thumb and great toe have only *two joints*, the above is really the true relation so far as concerns them alone; but Vicq d'Azyr had no reason for thinking so, since the opinion upon this matter which, then as now, was nearly universal, is well expressed in these words of a later writer, "il est évident pour tout le monde que le pouce est l'analogue* du gros orteil." Vicq d'Azyr seems rather to have been loth to enter into particulars, and really ignores the hand altogether; for it was doubtless the apparent parallelism between the foot and the hand in its ordinary state of pronation that induced him to force the whole limb into a similar relation by turning

*"It is evident to every one that the thumb is the analogue of the great toe." "Analogue" is here incorrectly used by Martins in the sense of "homologue"; in the correctly limited sense of the word, the thumb *is* the *analogue* of the great toe, but it is the *homologue* of the little toe.

the elbow forward; but when he is obliged to take the arm of the opposite side, he seems to have lost all faith in the hand, and leaves it in a position which, though correct in so far as the thumb is made to correspond with the little toe, is inconsistent with his own theory, and inadmissible on account of the displacement of the whole limb. And here was his error, in supposing that a rational comparison of the limb involved not merely a dislocation and reversion of the arm, but a transposition to the opposite side of the body, the right arm being thus made to correspond with the left leg, and the left arm with the right leg. And while we honor the great anatomist, who, in attempting a comparison between different regions of the same individual, really originated a new kind of Comparative Anatomy, which is destined to fill a large place in future investigations, we must deplore the method he employed, a method repugnant alike to common sense and the respect we ought to entertain for the relations God has established between the different parts of the animal frame. And it is doubtless to this pernicious example of Vicq d'Azyr that we must ascribe the extraordinary liberties which some of his successors have taken with the limbs, forcing upon them their preconceived ideas, as if each had said, "if the facts do not accord with my theory, why, so much the worse for the facts."

It is hard for us to believe that the great Cuvier, whose masterly demonstrations of corresponding parts in different animals constituted an era in anatomical science, and at the same time furnished the basis for a true classification, could have been so blinded by his exclusive devotion to Final Causes, and by his dislike for the transcendental theories of St. Hilaire as, during at least the greater part

of his life, to have attached little value to the comparison with each other of parts of the same body; but we could wish that he had ignored the subject entirely, rather than that in 1835 he should have lent the weight of his authority to the views of Vicq d'Azyr, as is shown by the following passage: "C'st la droite d'une paire qu'il faut comparer à la gauche de l'autre."*

Blandin, like Vicq d'Azyr and Cuvier, let the hand and fingers alone, the thumb still remaining opposite the little toe; but, in 1846, this inconsistency was pointed out by Turenne, who, desirous of making all things as harmonious as possible, in imagination, *cuts off the two hands* a little above the wrist, and *transposes them*, which of course brings the thumb on the inner borders, and opposite the great toe (Fig. 1 and 5); nor is it, perhaps, surprising that he should have regarded this as an improvement upon the proceedings of Vicq d'Azyr, and we ought rather to be gratified that, after putting the left arm in place of the right, and again changing the hands, he did not see fit to invert the entire limb, fasten the fingers upon the shoulder-blade, and declare the end of the arm-bone to be homologous with the great toe. Indeed, the whole proceeding is so extraordinary, that, but for the gravity with which it is proposed, one would incline to regard it as a burlesque, intended to bring the original view into ridicule. Yet only ten years ago, the doctrine of Vicq d'Azyr was again, though we hope for the last time, revived.

The errors in this view consist in the assumptions: 1. That the thumb corresponds with the great toe. 2. That the two limbs are parallel. 3. That it is either necessary or proper to compare the arm of one side with the leg of the opposite side.

*"It is the right of one pair that should be compared to the left of the other."

Fig. 1. Fig. 2. Fig. 3. Fig. 4. Fig. 5. Fig. 6. Fig. 7.

WILDER ON THE HAND.

EXPLANATION OF PLATE 12.

The bones of the limbs are marked as in Plate 11. F, *Femur*, or thigh bone; T, *Tibia;* Fi, *Fibula;* Pa, *Patella*, or knee-pan; Ha, *Hallex*, or great toe; H, *Humerus*, or arm bone; O, *Olecranon process* of elbow; U, *Ulna;* R, *Radius;* Po, *Pollex*, or thumb; Hd, *Head of Humerus*, or *Femur*.

Fig. 1. Bones of human leg, right side; the knee looks forward.

Fig. 2. Bones of human leg, right side; in the position in which Vicq d'Azyr began his comparison; the elbow looks backward, and the forearm is in pronation, the radius being crossed upon the ulna so as to leave the thumb on the inner side. (This and the three following figures are to be supposed *behind* Fig. 1, in order to be compared with it.)

Fig. 3. Right arm turned half way round so as to face the elbow forward like the knee; the hand remains as before, so that the forearm is untwisted, or supinated. The head of the Humerus now faces in the opposite direction to that of the Femur.

Fig. 4. Bones of *left* arm; all the parts agree with the leg except the thumb, which now comes on the *outer* side: this is as Vicq d'Azyr left it.

Fig. 5. This illustrates the comparison of Turenne. The upper parts of the limb are of the left arm as in Fig. 4; but the hand has been cut off and replaced by the right hand as in Fig. 3.

Fig. 6. Diagram of human fœtus, showing the rudiments of limbs.

REVIEWS.

Manual of the Botany of the Northern United States, including the District East of the Mississippi and North of North Carolina and Tennessee. Arranged according to the Natural System. By *Asa Gray*, Fisher Professor of Natural History in Harvard University. Fifth Edition. With twenty-five plates, illustrating the Sedges, Grasses, Ferns, &c. New York: Ivison, Phinney, Blakeman, & Co. Chicago: S. C. Griggs & Co. 1867. pp. 701. [*Not* including the Mosses and Liverworts, nor the "Garden Botany."]

This new edition of the "Manual of Botany" is the result of the author's continuous desire to improve and make more perfect an early one (published in 1848) "hastily prepared to supply a pressing want."

In the second edition, which appeared in 1856, 2,426 species of Flowering Plants, and the higher Cryptogams, or flowerless plants, were described. In the third and fourth editions species new to science, or newly discovered within our limits, were given in *addenda*, with such alterations in the stereotype plates as were possible. The present edition (almost entirely rewritten) is printed from new stereotype plates, and in it are described 2,634 plants of the Phænogamous and the higher Cryptogamous series; an increase in number of 208. In accounting for so great an increase, we find that 308 out of the whole number are introduced species, being forty-eight more than in the former edition; thirty or forty have hitherto been considered as varieties (or as included in other species), or are new species, and the remainder have been newly discovered within the geographical limits of the work, and, as might be supposed, occur mostly on the borders of the area treated of.*

The most important changes which we notice are the combination of *Nelumbiaceæ*, *Cabombaceæ*, and *Nymphæaceæ* proper as suborders of *Nymphæaceæ*; *Arenaria* is understood as comprising the (sub)genera *Honkenya*, *Alsine*, *Mœhringia*, and *Arenaria*; *Limnanthaceæ*, *Balsaminaceæ*, *Oxalidaceæ* and *Geraniaceæ* proper are now considered as suborders of *Geraniaceæ*; *Saxifragaceæ* is made to include *Grossulariaceæ* and *Parnassiaceæ*; *Holorageæ*, previously merged in *Onagraceæ*, now takes rank as a distinct order; and *Loganiaceæ* has been removed from *Rubiaceæ* to its place between *Gentianaceæ* and *Apocynaceæ*. *Calluna vulgaris* is regarded as a native plant. Our species of *Cuscuta* are described for the "Manual," by Dr. George Engelmann, of St. Louis, Mo.; the name *Lindera* has to be substituted, by the inexorable rule of priority, for the familiar one of *Benzoin*; the genera *Callitriche* and *Euphorbia* have been carefully reëlaborated, as to our species, by Dr. Engelmann, for this edition; the *Cupuliferæ* and *Betulaceæ* have been thoroughly overhauled; the genus *Lemna* has been carefully revised with the aid of notes contributed by Mr. C. F. Austin, and the genus *Wolffia* (represented by *W. Columbiana*)† is now for the first time indicated in a Handbook of Botany, as found in America, though discovered many years ago by Dr. Robbins, who has now monographed anew our species of *Potamogeton*. *Habenaria* is now introduced as including all our species of *Platanthera* and *Gymnadenia*; *Spiranthes*

* The species which are described as new are Lechea Novæ-Cæsaræ, Polygala Curtisii, Sium Carsonii, Aster Herveyi, Lobelia Canbyi, Pyrola oxypetala, Hydrolea affinis, Callitriche Austini, Lemna Torreyi, Potamogeton Oakesianus, P. Vaseyi, Spiranthes simplex, Pogonia affinis, Juncus Smithii, J. Vaseyi, J. asper, Cyperus Lancastriensis, Scirpus Smithii, Aristida ramosissima, Avena Smithii, Isoëtes Tuckermani, and I. saccharata.

† Dr. Engelmann has discovered very recently a second (European) species, *W. arrhiza*, on ponds near St. Louis, Mo.

has undergone changes for the better, and *S. Romanzoviana*, hitherto identified only on the western slopes of North America, where it was long ago found by Chamisso, and at the single station of Bantry Bay, Ireland, is found to be present in the northern part of our region. *Liliaceæ* now includes *Melanthaceæ* and *Trilliaceæ*, and the genus *Narthecium*, and the *Junci* have undergone a careful and critical revision at the hands of Dr. Engelmann. Much laborious study has been given to the *Cyperaceæ*, and we see the number of *Carices* raised from one hundred and thirty-two to one hundred and fifty-one; the Ferns have been contributed by Professor D. C. Eaton, of Yale College, who has introduced a few changes which we are glad to see, as with *Pellæa* and *Allosorus*, *Polypodium* and *Phegopteris*, and the species of *Botrychium*. The account of our species of *Isoëtes* has been contributed by Dr. Engelmann, who has given them much careful study, and who characterizes within our area seven species, while there are two more in the Southern, and three more in the Pacific States.

We are glad to see the promise of a "simpler and more elementary work," which will include the "Garden Botany" of the last edition, and more, and "designed especially for school instruction, and for those interested in cultivation,—entitled *Field, Forest*, and *Garden Botany*." We shall also look with eagerness for a supplementary volume, to contain the *Mosses* and *Liverworts*, newly elaborated we suppose, and the "*Lichens*, if not all the other orders of Lower Cryptogamia." Above all we congratulate Botanists that there is a prospect of the issue, before many years, of a somewhat similar Flora of the whole national domain.

The addition of six beautiful new plates (in the admirable workmanship of Mr. Isaac Sprague), of the genera of *Cyperaceæ*, is an important item to the beginner, and even to those more thoroughly versed in Botany. Every one will be pleased with the slight changes in the typographical execution and arrangement of the work.—H. M.

NATURAL HISTORY MISCELLANY.

BOTANY.

Botanical Notes and Queries. A recent number of the *Revue Horticole* (Aug. 16, 1867) calls in question the native country of *Sambucus Canadensis* Linn., our common Elder, not only regarding it as a mere variety of the European *S. nigra*,—which it well may be,—but doubting if it be really indigenous to this country. The same doubt had been raised in my own mind. Can any of the numerous readers

of the AMERICAN NATURALIST resolve the doubt by indicating any locality for it away from roadsides and cultivated ground, and quite free from suspicion? The same journal calls more decidedly in question, the American origin of *Robinia hispida*, the common Rose Acacia, and conjectures that it is an extraordinary form of the common Locust. This more unlikely opinion is based on the fact that this shrub sets no fruit either in the old world or the new; also that, on inquiry, no one seems to know it away from cultivation. This year, however, some pods are forming in France. Has any one seen pods and seeds in this country? The inquiry is in this case particularly addressed to Southern correspondents. There are in cultivation forms singularly intermediate between *R. hispida* and the *R. Pseudacacia*, or common Locust, but these are more likely hybrids. The Rose Acacia is said to be indigenous to Georgia, apparently with good reason. But definite indications of it, and fruiting specimens are desirable.

As the above-mentioned number of the *Revue Horticole* gives a figure and description of that charming hot-house climber, *Clerodendron Thompsonæ*, I may take this occasion to refer to the curious, and perhaps as yet unnoticed, arrangement of its stamens and pistils, so as to favor, if not to secure, *cross-fertilization*. The long and slender filaments and style in the flower-bud are rolled up in an incurved coil, after the manner of the genus. When the crimson corolla opens, setting these organs free, the filaments straighten at once into nearly a horizontal position, and their anthers opening are covered with fresh pollen; while the slender style is strongly recurved, carrying the forked stigma downwards and backward far under the flowers. After about twelve hours, say at sunset when the blossoms have opened in early morning, the filaments begin to curve downwards, and the style to straighten; and before the next morning the filaments are rolled up into a spiral coil the reverse of that in the bud, placing the anthers under the tube of the corolla, while the style has risen to the horizontal or slightly ascending position, so placing the stigma where the anthers were the day before. Evidently there is only a short period during which a moth, or such insect, visiting the flowers can brush any pollen from the anthers to their own stigma; but the pollen of freshly opened flowers will, in the progress of the insect from blossom to blossom, be carried to the stigma of those which have expanded the day before. — A. GRAY.

May-apples in Clusters. — In the new edition of the "Manual of the Botany of the Northern States," it is too briefly mentioned that *Podophyllum* has been found in Ohio, by W. C. Hampton, with two carpels! I would here add, that, on a visit to the Agricultural College of Penn-

sylvania last summer, my friend, Professor H. J. Clark (whose acute original observations I have frequently had to record), showed me several clusters of well-grown fruits of *Podophyllum*, of three or four upon one stalk, and evidently from one flower; and I think he remarked that they were not very uncommon. I wish to obtain some of these anomalous *Podophyllums* in flower. There is reason to expect now and then a similar monstrosity in *Jeffersonia;* and the matter has a certain botanical interest beyond the mere curiosity of the thing. — A. GRAY.

Invasions of Foreign Plants. — The prepotency of foreign plants over original vegetation, especially in the New World, in New Zealand, Australia, etc., has of late attracted attention and remark. That foreign weeds should usurp the cleared soil in this part of the country, which was originally forest-grown, is only what would be expected. But the vegetation of our more unwooded regions West and South ought to furnish plants capable of holding their own against intruders, even under present changed conditions, unless, as has been suggested, a set of plants of the Eastern world which have fought their way into Europe against all indigenous opposers, have thereby at length acquired a hardihood and generally belligerent disposition, which enables them to conquer new worlds wherever they get a foothold. Somehow or other these plants do seem, in this respect of prepotency, to take after the particular human race whose footsteps westward they follow.

These remarks are suggested by a recent instance of the sort, on the part of a Chinese or Japanese leguminous plant, *Lespedera striata* Hook. and Arn., which has got an introduction, nobody can tell how, into the interior of Alabama, Georgia, and South Carolina, and is now multiplying at a wonderful rate. I first received it a year ago, but Professor Darby informs me that he detected it about ten years ago, at the railroad station in Altoona, Georgia, and he has lately met with it in all the adjacent States. "Now," he adds, "it covers thousands of acres, and is rooting out everything, even our Bermuda Grass (itself a foreigner). "When I first came to this place [Auburn, Georgia], the *Maruta cotula* covered all waste places; in a few years the [native] *Helenium tenuifolium* took possession. Now, this *Lespedera* has conquered them both." The newspapers have lately mentioned that "a new grass, of the nature of a clover," has widely appeared in the Southern States. This is probably the thing. If it be a decent forage plant, as it well may be, this intruder, which takes such a liking to the poor soil of the South, will prove a real blessing to the country. — A. GRAY.

A VARIETY OF THE OX-EYE DAISY.—I am not a little interested in the note in the NATURALIST for September, by Professor Tenney, in relation to the form of the Ox-eye Daisy, which he suspects to be new. Although this form may be new to science, in that it has not been hitherto described, yet this is certainly not the first time it has been detected. Within a period of fifteen years past, I have found it some three or four times, I think; and I never suspected it to be anything but a chance variety of *Leucanthemum vulgare*. In the summer of 1865, it was brought to me from a spot close by my house, agreeing in all respects with the description by Professor T.; and wishing to try the effect of cultivation upon it, I transplanted a good root to my garden, but it was afterward destroyed by accident, before the result could become known. I cannot believe it to be specifically distinct from the common *Leucanthemum*, or anything more or less than a variation, through accidental causes, from the normal state of the species. To my mind it stands in the same line with the petaloid form of *Penthorum*, or the "*Peloria*" condition of *Linaria vulgaris*; and many other genera might be cited as furnishing instances of like departures now and then from the ordinary and natural style.—C. M. TRACY.

ZOÖLOGY.

THE BREEDING HABITS OF BIRDS.—In reading the lately published work of Mr. Samuels, on the Ornithology and Oölogy of New England, I noticed some statements regarding the breeding habits of some of our birds, which are at variance with my own observations.

Of the Belted Kingfisher he says: "The birds on arriving commence pairing, and they soon begin excavating in a sand-bank a long, winding hole, of about three inches and a half in diameter at the entrance, and gradually larger to the end, at which the nest, composed of grasses, leaves, and feathers, is built,—or laid, which would, perhaps, be the better term. This hole is sometimes as much as six or eight feet, usually from four to six, in length." Page 126.

My experience in regard to the breeding habits of the Kingfisher is entirely at variance with the above. Of two burrows found last spring, one measured thirty-four, and the other thirty-five inches in length; they were excavated in the form of an elbow. The passage leading from the entrance in one of them was sixteen inches in length; and then turning to the right, lead to a cavity of about ten inches in diameter, the bottom of which was three-fourths of an inch below the bottom of the way leading to it, and four and a half inches in height, being in the form of an oven; including the cavity,

the length of this part of the burrow was eighteen inches. The eggs were placed in the hollow *on the bare earth.* I have seen many of their burrows, and have yet to find one in which a nest is made of any material.

Again he says: "The Mottled Owl selects for a nesting-place a hollow tree, often in the orchard, and commences laying at about the first of May, in the latitude of the middle of Massachusetts. The nest is made at the bottom of the hollow, and is constructed of grass, leaves, moss, and sometimes a few feathers. It is not elaborately made, being nothing more than a heap of soft materials." Page 67.

This is another instance in which the bird makes no nest, or at least I have never found one. All rapacious birds are awkward workmen at nest-building, especially the Owls. Those Owls which occupy a nest at all, usually select the abandoned nest of the Crow or Hawk; sometimes they select one in a most dilapidated state, in which case they repair it with dried sticks, sometimes green ones with the leaves adhering, which they break from the neighboring trees; and with bark collected from dead limbs, etc.; very seldom do they construct a new nest.

The difficulty with which Owls and Hawks obtain the material for building their nests, compels them to use the same nest year after year; the upper mandible so overhangs the lower one, that it is difficult for them to pick up a stick from the ground, and they often use their claws to carry the material.

Had not Mr. Samuels been an eye-witness of the weaving capacity of the Marsh Hawk [page 48], I should doubt the power they possess in so combining the materials of their nest as to cause them to appear to be woven. In many instances they merely trample down the grass in the meadow, and lay their eggs on the bare turf; and when they pretend to build a nest it will not compare in architecture with that of the common hen.

I make these statements, because I believe facts concerning the habits should be given as well as the minutiæ of classification, as in this way information will be the better imparted to those seeking knowledge; and we shall then have the natural history as well as the nomenclature of birds.—AUGUSTUS FOWLER, *Danvers, Mass.*

CHANGE OF COLOR IN FISH.—A medium-sized "horned-pout," in a dining saloon in this city, changed color in a few days from black to a very bright clear color. The fish has remained in running water some weeks in a set marble bowl, where soft water runs all the time. This fact may help to confirm Mr. Bolles' observation mentioned in the NATURALIST, p. 391.—W. B. CHAMBERLAIN, *Worcester.*

ANSWERS TO CORRESPONDENTS.

Can you inform me what is the use of the comb-like formation on the inside of the middle claw of the Night-heron, the Night-hawk, and Whippoorwill? Is it peculiar to night birds? I find it on those mentioned, and have not noticed it on any bird of the day that I have shot, or is in my collection. — BALDWIN COOLIDGE, *Lawrence.*

We referred these questions to Dr. T. M. Brewer, who thus writes: I have shown your letter to Mr. G. A. Boardman, and have secured a very satisfactory explanation from him of the purpose and use of the "formation" in question. It is used by the birds to clean their heads, and such portions of their neck, back, etc., as they cannot reach with their bills. He often finds them containing feathers, down, dead skin, etc.

H. W., Massachusetts.—The Fern, from Genesee, N. Y., you enclose, is apparently nothing but a poor specimen of *Asplenium thelypteroides* Michaux.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.—NATURAL HISTORY SECTION. *Burlington, Vt., August* 21–26, 1867. "Considerations relating to the Climate of the Glacial Epoch in North America," by Professor E. Hungerford. The special object of this paper was to discuss the growth and the climatic influence of such an accumulation of snow and ice as the glacial hypothesis supposes to have once existed.

The author called attention to the extremely broken condition of the northern border of the continent, and to the probable effect of a local elevation of that region above its present level, in lowering the snow line by a depression of the summer temperature. A large extension of the area of perennial snow would result from this. But every one hundred feet of snowy accumulation would be more than equivalent in climatic effect to a hundred feet of continental elevation, owing to the peculiar nature of a snowy surface. Every such additional accumulation would depress the summer temperature still farther, and give further extension to the area of perennial snow. This process would go forward until some great reactionary cause is introduced. We should thus have a great snow and ice plateau, covering the northern portions of the continent, without resorting to a very extended upward movement of the continental mass.

The paper then entered upon a discussion of the direct frigorific effects of such an immense plateau, composed of such material, contrasting it with a similar plateau of bare earth, and applying to it various meteorological considerations, all tending to show that in the interior of such a plateau an intensely cold climate would continue through the year.

Application was made of these considerations to the question of a simultaneous motion of a continental glacier in one determined direction. Extreme cold operates adversely to glacial motion, and ground was taken against the probability of such a general simultaneous movement, in such a climate and with no sufficient slope of the country.

The erosive effects which we witness, and which are due to glacial action, are ascribed to a motion always sustained along the southern or seaward margin of the glacier, where a milder climate would prevail. The glacial front itself furnishes the slope, and heavy precipitation above supplies the waste below. Every section of country is twice scoured over,—once during the growth, and once during the retreat of the glacier. By the same motion the detritus is transported over limited distances. For the remote transportation of drift, the agency of icebergs and ice-rafts is necessary. This latter point is discussed in the paper on the Ripton Sea-beaches.

"The Ripton Sea-beaches," by Professor E. Hungerford. This paper gives a somewhat detailed description of a series of terraces, situated on the west flank of the Green Mountains, in Vermont, on the pass from Ripton to Hancock. They are elevated 2,196 feet above the ocean. Drawings were exhibited in which the distinct terrace forms were displayed, extending up the gorge which forms the pass. Evidence was adduced to show that the materials of the terraces overlie the true boulder drift of the region, and that they thus constitute a modified drift deposit, worked down by waves and currents into their present position and form. The configuration of the country being regarded as unfavorable to the accumulation of a large body of fresh water at this point, these deposits are cited as a strong confirmation of other evidence, that this region has suffered a depression of at least 2,000 feet beneath the sea since the glacial epoch proper.

The author of the paper took occasion to concisely present his views in regard to the causes operating to produce the drift phenomena. The geological events enumerated succeeded each other in the following order:—

1. The formation of a continental glacier to whose partial movements, always limited to a comparatively narrow belt upon the southern or seaward margin, are due the erosive phenomena, and the transportation of the drift over limited areas.

2. A depression of the continent, bringing the ocean into contact with the long glacial border, which, on its retreat, sends off icebergs and icerafts into the ocean. To these are attributed the further transportation of detritus and boulders.

3. Emergence of the continent,—the higher beaches marking the earlier, and the Champlain terraces the later stages of this process.

"On the Geological Relations of the Mastodon and Fossil Elephant of North America," by Professor James Hall, of Albany. Professor Hall spoke of the geological position in which remains of the mastodon had been found. These remarks chiefly applied to those specimens found in the State of New York, especially describing the location and position in which the skeleton was found at Cohoes last autumn. He was inclined to think that these remains were left in their scattered position by the melting of a glacier. He considered the facts as evidence that the mastodon extended back to the close of the glacial epoch. The paper stimulated so lively a discussion that the time of the session was extended three-fourths of an hour, when a farther discussion was postponed till the next day. During the discussion Professor O. C. Marsh, of Yale College, said that he had seen mastodon bones from Kentucky scratched and furrowed like glacial boulders. Remains of two or three species are found in North America, one of which found in the upper Missouri region lived in the Tertiary period, and hence was much more ancient than that found at Cohoes. It is known that the mastodon lived in Europe and in India previous to the glacial epoch, and he showed that the American facts perfectly coincided with foreign observations. He noticed that remains of an elephant, identical with the one found in Siberia, were numerous in Russian America, and he suggested that the day might come when fossil ivory would become an important article of export from that territory.

"Considerations drawn from the Study of the Orthoptera of North America," by S. H. Scudder, of Boston. This paper gave a general account of the Orthopteran (grasshoppers, crickets, and the like), fauna of North America compared with that of Europe; showing the greater comparative richness of the American fauna under similar climatic influences. It was followed by a more detailed notice of the groups which are characteristic of one continent in contrast with those forming the essential features in the fauna of the other.

"On recent Geological Discoveries in the Acadian Provinces of British America." By J. W. Dawson, LL.D., F. R. S., Principal of McGill University. The object of the paper was to notice some recent discoveries, which, though of interest, might have escaped the notice of members of the Association.

In New Brunswick, the older rocks in the vicinity of the city of St. John have been reduced to order, and their probable ages ascertained, principally through the labors of Mr. Matthew, Mr. Hartt, and Professor Bailey. The first step toward the knowledge of their precise date was the discovery of a rich land flora in some of the upper beds, next below the Lower Carboniferous rocks which overlie them unconformably. These fossil plants I was enabled to recognize as of the Devonian Period, and the zealous researches, more especially of Mr. Hartt, have brought to light no less than forty to fifty species, or half of the whole number known in the Devonian of Eastern America, as well as six species of insects, four of which have been described by Mr. Scudder.* These insects are the first ever found in rocks older than the Carboniferous.

These rocks, consisting chiefly of hard shales and sandstones, having been ascertained to be Devonian, there still remained an immense thickness of underlying rocks of uncertain age. In the upper member of these rocks, the same active observers already mentioned have observed a rich primordial fauna, embracing species of *Conocephalites*, *Paradoxides*, *Microdiscus*, and *Agnostus*, as well as an *Orthis*, and a new type of Cystidians. These fossils are regarded by Mr. Hartt and Mr. Billings as of the age of Barrande's "Etage C," and as marking a new and older period of the "Silurian Primordial" than any other as yet recognized in America, with the exception of the slates holding *Paradoxides* in Massachusetts, and the similar slates of the "Older Slate Formation" of Jukes, in Newfoundland. Descriptions of these fossils, by Mr. Hartt, will be published in the edition of "Acadian Geology" now in press. It is proposed to call this series, represented in New Brunswick by the St. John slates, the *Acadian Series*.

Below these primordial beds are highly metamorphosed rocks, at least 9,000 feet in thickness, which have afforded no fossils. A portion of these beds, consisting principally of conglomerate and trappean beds, is regarded by Messrs. Matthew and Bailey as of the age of the Huronian. The remainder, containing much gneiss and a bed of crystalline limestone, they regard as Laurentian. If this view is correct, and it certainly seems to be probable, these rocks thus rising through the oldest members of the Lower Silurian, and forming a stepping-stone between the Laurentian of Newfoundland and that of New Jersey, show that the foundations of the north-east and south-west line of the east side of North America were already laid in the Laurentian period. Still, it is not here, but farther west, that we are to look for the dividing line between the great inland Silurian basin of America, and that of the Atlantic coast; the latter as has been pointed out by

* Canadian Naturalist and Geologist. 1867.

Professor Hall and Sir W. E. Logan, so remarkably distinguished by the predominance of mechanical sediments, and by a development of the lower rather than the upper members of the Lower Silurian.

To ascend from these rocks to the Carboniferous,—recent labors of Mr. Davidson, Mr. Hartt, and the author, had led to the division of the Lower Carboniferous into successive subordinate stages, and to the determination of most of the marine fossils, and also to the explanation of the curious and apparently anomalous fact that some forms allied to Permian species actually exist in the Lower Carboniferous, under the productive coal-measures. These researches had also shown that no distinction between Sub-carboniferous and Carboniferous proper, can fairly be made in Nova Scotia, notwithstanding the grand development of the Carboniferous in thickness.

After noticing the large advances made in the fossil botany of Nova Scotia and New Brunswick, the paper referred to the discovery by Mr. Barnes of two new species of insects, and to the discovery by the writer of a new pulmonate mollusk, described by Dr. P. P. Carpenter, as *Conulus priscus*. There are thus in the coal formation of Nova Scotia a *Pupa* and a *Conulus* or *Zonites*, generically allied to living pulmonates, and representing already in that early period two of the principal types of these creatures.*

Specimens of these fossils were exhibited, and also specimens and a photograph of the Laurentian fossil *Eozoön Canadense* sent by Sir W. E. Logan. Special attention was drawn to the specimen recently found by the Canadian Survey at Tudor, which shows this organism in a state of preservation comparable with that of ordinary Silurian fossils.

"On the Distribution of Radiata on the West Coast of America." By Professor A. E. Verrill. In this paper the author has endeavored to present all the facts hitherto published in regard to the geographical distribution of the Radiates along the entire Pacific coast of America, as well as many new observations upon those found in the tropical region.

The present state of our knowledge indicates that the entire coast may be divided into at least eleven regions, or zoölogical provinces, each characterized by a peculiar assemblage of species and genera, some of which are restricted to each province, while others pass the bounds into adjacent provinces, on one or both ends, in diminished numbers. Temperature was shown to be the principal physical agency in limiting the distribution of species, but the nature of the bottom and the character of the shores have their influence. The depth of water probably has a direct influence on certain

*Acadian Geology. Second Edition.

species, but its principal influence is *indirect*, by influencing temperature, increase of depth being, in the sea, analogous to increase of elevation upon land, diminishing the temperature and allowing northern animals to extend in deep water farther toward the equator than upon the shore. The number of species of each class of Radiates found in the several provinces was stated, together with those that were peculiar to it, and those that range into other provinces north or south. The Arctic division of the coast north of Sitka, was shown to be characterized chiefly by circumpolar species, found also on the North Atlantic coasts of America and Europe, and, in some cases, upon the North Pacific coast of Asia; several of the common New England Star-fishes, Sea-urchins, and Actiniæ are examples of species having this wide northern distribution. Each of the other provinces was compared with the adjacent ones, and with the parallel provinces of the Eastern American coast and the coast of Europe, most striking resemblances to the latter being common. The Tropical or Panamian province, extending from the head of the Gulf of California and Cape St. Lucas to Cape Blanco, Peru, was compared with the Caribbean province, extending on the Atlantic coast from Florida to Brazil, and including the West Indian Islands. Very few species of Radiates are recorded as identical between the Atlantic and Pacific, and these are all Holothurians, and therefore doubtful. The Polyps and Corals are remarkably different, not only in species, but often in genera and families. No coral-reefs occur on the Pacific side, but several corals of considerable size occur. The Panamian Acalephs are almost unknown. A small per cent. of Mollusca are admitted as identical on the two coasts, by Dr. Carpenter, and of Crustacea and Fishes by others; but the general correspondence in the genera and families in these groups and in Echinoderms is very remarkable. There is no direct evidence of a water communication across the Isthmus since the Cretaceous period, but shells have been found in the Miocene of San Domingo, and near Aspinwall, allied more nearly to living Panamian shells than to those of the Atlantic. All the evidence is against the supposition that the Gulf Stream has flowed across the Isthmus, since the existence of living species. And there is more evidence of existing Pacific species passing into the Atlantic, than the contrary.

In conclusion, it was thought that a depression of about three hundred feet, causing a connection across the Isthmus by means of a shallow estuary of brackish water, sufficiently pure to sustain the life of many Mollusca, Crustacea, and Fishes, but not the floating germs of Corals and other Radiates, would sufficiently account for the distribution of all the known identical species. But to account for the distinct but similar species belonging often to genera not found in the East In-

dies and Central Pacific, it will be necessary to suppose that they were created separately, as we find them, each adapted to its province; or else that they have descended from common ancestors, becoming gradually different by natural selection or otherwise, and pointing to an earlier, very ancient, and extensive connection between the two oceans.

Prof. O.C. Marsh exhibited some remarkable fossil Sponges from the Lower Silurian of Kentucky, for which he had recently proposed the new genus *Brachiospongia*. The type of the genus was *B. Rœmerana*, and several other species have recently been discovered. These forms are very unlike any known sponges, recent or fossil, and are of great scientific interest. A full description of them will soon be published.

"On certain Effects produced upon Fossils by Weathering." By Professor O. C. Marsh. Certain peculiarities in some fossil shells, which had been a puzzle to the German geologists, were very clearly explained by Professor Marsh as due to the action of the elements, the parts of the shell being differently composed and of different degrees of hardness. This has been most frequently noticed in fossil Cephalopods, which in some instances show lobe-lines, characteristic of two different genera on the same specimen. This is very often the case with *Ceratites nodosus*, from the Trias of Germany.

NOTE.—This number is devoted largely to the proceedings of the American Association for the Advancement of Science. In order to make room for the valuable and interesting address of the President, and the abstracts of papers read in the Natural History Section, we have crowded out articles and illustrations originally intended for this number.

We trust all our readers will feel an interest in the growth and full success of the American Association, whose meetings are doing so much for the diffusion and advancement of Science in this country, and prove such pleasant reunions for all interested in the cause.

The abstracts of the papers will be continued in future numbers.

BOOKS RECEIVED.

Life Beneath the Waters; or the Aquarium in America. By Arthur M. Edwards. New York, 1858. 12mo. Illustrated.

On a Fungoid Parasite, or Caterpillar Fungus, from the Philippine Islands. By Dr. Samuel Kneeland. (From the Proceedings Boston Society Natural History.) 1867. 8vo, pp. 6.

Notes on Fossils recently obtained from the Laurentian Rocks of Canada, and on objections to the organic nature of Eozoön. By J. W. Dawson, LL.D.; with Notes by W. B. Carpenter. Plates XI and XII. (From the Proceedings of the Geological Society, London, May 8, 1867.) 8vo, pp. 7.

Catalogue of the Lepidoptera of New Orleans and its vicinity; prepared by L. Von Reizenstein. New Orleans, 1863. 16mo, pp. 10.

Mental and Social Culture; a Text-book for Schools and Academies. By L. C. Loomis, New York. J. W. Schermerhorn & Co. 1867.

OBITUARY NOTICE.

It is our painful duty to announce the death of the President of the Essex Institute, which took place at his residence in Salem, on Thursday evening, October 31, 1867.

Francis Peabody, born at Salem, December 7, 1801, was a son of Joseph Peabody, an eminent merchant of Salem during the close of the last and the beginning of the present century. Soon after leaving school he made an excursion to Russia and Northern Europe, and on his return settled in Salem, where he continued to reside until his decease, except during occasional visits to Europe. He was early interested in the study of chemistry and the kindred sciences, and their application to the useful arts. He was the first President of the Board of Trustees of the Peabody Fund for the promotion of science and useful knowledge in the County of Essex; a member of the American Academy of Arts and Sciences, and other institutions.

In November, 1827, the Essex Lodge of Free and Accepted Masons, in Salem, of which body he was an honored member, voted to have a course of Literary and Scientific Lectures; about the same time the Salem Charitable Mechanic Association appointed a committee to provide for the delivery of lectures before the members and their families. Before both of the above-named institutions Mr. Peabody delivered several lectures on the Steam Engine, Electricity, Galvanism, Heat, and similar subjects. At the organization of the Salem Lyceum in January, 1830, Mr. Peabody took a leading part, and was on the first board of management, and delivered several lectures on scientific subjects. These several institutions may be considered as having made the first movement in the general introduction of popular and instructive lectures, which have been so universally adopted in this country.

About 1826 Mr. Peabody engaged in the manufacture of white lead, which business he pursued until 1843. During that period he was also interested in the manufacture of paper and linseed oil, and owned establishments for the refining of sperm and whale oils. From that

time, until his decease, he engaged extensively in commercial enterprises, in connection with one of his sons, and had recently erected a mill for the manufacture of gunny cloth on new principles.

Mr. Peabody had a very active and inventive mind, and was always interested in the conducting of experiments in the Physical Sciences, or in the invention of machinery useful in the arts. He had always been an efficient and zealous member of the Institute, and in May, 1865, was elected its President; during his official connection with that body he contributed very largely for the promotion of its objects.

The decease of the President will not only be a great loss to the Institute but to the community in which he had spent an active and useful life. His memory will long be cherished for his many virtues and his great interest in all worthy undertakings.

At a meeting of the Essex Institute, held on Saturday, Nov. 2, 1867, Vice-President A. C. Goodell, jr., in the chair, the following Resolutions, offered by Henry Wheatland, were unanimously adopted: —

Resolved, — That the Essex Institute receives the tidings of the decease of its President, FRANCIS PEABODY, Esquire, with profound sorrow; that in his death it recognizes the loss, not only of its most devoted, laborious and enthusiastic chief officer, but of a friend and patron of science and the useful arts, who, while distinguished for his accomplishments in a wide field of intellectual inquiry, was indefatigable in reducing the results of his investigations to practical use; a citizen who used his liberal means to advance the welfare of his neighbors by the encouragement of industry and the discovery of new sources of profit; a man whose life was characterized by untiring devotion to those studies and pursuits which lead to the highest and most enduring prosperity of any community, and, in its more intimate and private relations, was pure and blameless.

Resolved, — That, as a mark of respect to the memory of the deceased, the Rooms of the Institute be closed to the public on Monday, Nov. 4, and that the members assemble at this place on that day, at 12.30 P. M., to attend the funeral of their late President.

Resolved, — That the Hon. C. W. Upham be invited to prepare a Eulogy upon the life and character of the deceased, to be read before the members of the Institute at such time as shall be hereafter determined upon; and that the Trustees of the Peabody Fund be invited to participate in the exercises of that occasion.

Resolved, — That a copy of these Resolutions be presented to the family of the deceased, to whom the Institute hereby tenders its sincerest sympathy and condolence; and that a copy be also forwarded to George Peabody, Esquire, of London, who so much relied upon the deceased for the wise management of his large donation for the promotion of science and useful knowledge in the County of Essex; between whom and the deceased the warmest feelings of kindred and friendship existed.

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DESMIDS AND DIATOMS.

BY PROF. L. W. BAILEY.

It is the purpose of the present article to present in a familiar way the more important features in the structure and history of some organisms in general but little known, the DESMIDIACEÆ and DIATOMACEÆ, and to suggest a few reflections upon their habits and economical value, but more especially their importance, both in past ages and at the present time, in modifying the physical features of the globe.

Without entering into the facts of the discovery and history of these microscopic Algæ, it may be sufficient to say that they were originally included, together with two other very interesting groups, the Polygastrica or Many-stomached animals, and the Rotatoria or Wheel-animalcules, by the Prussian naturalist, Ehrenberg, under the common name of Infusoria. It is much to be regretted that a systematic classification, embracing numerous sub-families, genera and species, should thus have been introduced into scientific nomenclature, at a period when so little was really known of the true position of these organ-

Entered according to Act of Congress, in the year 1867, by the ESSEX INSTITUTE, in the Clerk's Office of the District Court of the District of Massachusetts.

isms, and that names devised to represent their supposed characters, but calculated to lead into constant error, should thus have been perpetuated. The name of Infusoria, applied to the whole assemblage of animated forms first revealed by the microscope, was derived from the invariable presence of these bodies in all infusions of decaying animal and vegetable matters. It is to their rapid appearance and development under circumstances calculated to remove or destroy all germs of organic life, that the doctrine of *spontaneous generation*, still maintained by many able observers, owes its origin. Into the character and habits of the Infusoria proper, or Protozoa, as they are now called, as well as those of the Rotatoria or Wheel-animalcules, I do not now propose to enter. Suffice it to say, that the two remaining families, the Diatoms and Desmids, after repeated tossing from the one kingdom to the other, are now universally admitted into the department of the botanist, and can really have nothing in common with that of the zoölogist.

The Desmids and Diatoms were grouped together by Ehrenberg, under the single name of the Bacillariæ, from *bacillum*, a rod or wand, a name singularly inappropriate as applied to the whole family, including as it does a large proportion of forms having no such resemblance. By naturalists of later years the two are included as coordinate suborders of the minuter Cryptogamia, termed Algæ by botanists.

The Desmids, or Desmidiaceæ, so called from the partial division of the single cell of which they consist into two by a deep constriction in the middle, which is highly characteristic of the whole family, are pseudo-unicellular algæ of a beautiful green color and great variety in size and outline. Unlike the Diatomaceæ, they are confined

solely to fresh water, where their delicate green cells, forming mucous tufts or films on the surface of boggy pools, or coating the stems or fronds of aquatic plants, often multiply in sufficient numbers to impart a pale green tint to the water. Only the most quiet and the purest water seem favorable to their growth. Running streams, brackish inlets, the turbid waters so productive of the minuter forms of animal life, seem wholly unfitted for these delicate organisms. As a general rule they are much less numerous than the Diatoms, the latter far exceeding them in families, genera, and species, as well as in the number of individuals. Their outline is very varied, but generally characterized by a great number of incisions of greater or less depth, which seem constantly tending to divide the original cell into a number of smaller ones. Many of them have in general a circular outline, but still marked with deep constrictions (as *Micrasterias*, Pl. 13, fig. 4), others are lengthened and sigmoid (*Closterium*, fig. 5), recalling some genera among the Diatomaceæ; others, again, are compound or concatenate; and yet others, like the Diatoms, form long and waving graceful filaments. A tendency also towards outward development, as shown in the numerous projecting arms which are so prominent on many species (figs. 1, 2, 6), is also a noticeable feature in their structure, and aids greatly in the determination of their specific characters and their relations to other families.

The Desmids consist, as I have said, essentially of a single cell. This cell has the usual number of external coatings, a membrane of firm though flexible consistency, often containing particles of silica, and showing the affinities between this family and the Diatomaceæ; a second coating or "primordial membrane" included within the

former, and containing within its cavity the "endochrome," or green coloring matter, which seems to be analogous to the chlorophyl or leaf-green of the higher plants; and, lastly, a thin hyaline membrane enclosing the two former, and analogous to a similar membrane among the Diatomaceæ. The surface of the cell thus enclosed is often ornamented by the existence of numerous markings, striæ, lines or dots, but still oftener by the presence of projecting points or spines, which give to many of the genera a singularly beautiful appearance. In the interior of this cell may sometimes be seen a curious movement of the cell contents, which has given rise to much discussion among the students of these forms. Some assign the circulation thus witnessed to ciliary action, others to the spontaneous movement of enclosed zoöspores; but as this is still a debated point, I shall not at present dwell upon it. The same is true of the motion quite commonly observed of the whole Desmid through the medium in which it lives, with a slow majestic movement, very suggestive of animality, and which caused these organisms to be assigned by the earlier writers to that kingdom. The existence of external "cilia," either in these or in the Diatomaceæ is exceedingly improbable. Like other plants, they have a marked tendency to travel towards the light, and have sufficient power of locomotion to penetrate to the surface of mud in which they have been imbedded during the drying up of pools.

The multiplication of the Desmids is accomplished by two methods: by self-fission, or the dividing of the cell-contents into two portions, as is commonly the case with all Algæ; or, secondly, by a true generative process, and the formation of "Sporangia." As, however, these processes are very similar to those which characterize the

reproduction of the Diatomaceæ, and as it is chiefly of the latter that this article is designed to treat, it is unnecessary to enter into a more minute description.

Before dismissing the subject of the Desmidiaceæ, I may say that they are exceedingly common, especially in open tracts, abounding in exposed localities. They are exceedingly beautiful, and, with the Diatoms, which are always associated with them, form objects well worthy of search on the part of those provided with the proper instruments to discern their beauties. They are very tenacious of life, I having frequently found them still green and healthy in bottles of water from which all other varieties of vegetable life had long since disappeared. As agents in the mechanism of Nature, the Desmids play an important part, not only by directly serving as the food of many aquatic animals, but also by their furnishing, in company with other plants, the oxygen which is so necessary for the purity of the water in which these animals are to dwell.

Lastly, the Desmids have a peculiar interest from the fact, that, notwithstanding their being destitute of the hard parts which constitute the fossil remains of other plants and animals, they are yet found in considerable numbers in the fresh-water marls of North America, and bodies bearing a striking resemblance to their Sporangia occur abundantly in the silicious nodules of the chalk, and even in the flinty hornstone of the Silurian and Devonian eras.* To this fact allusion will again be made in the discussion of the geological relations of the Diatomaceæ.

*It is generally stated that these organisms, termed Xanthidia, are the sporangia of Desmids; but if so, how is it that they occur in marine deposits, such as the chalk and hornstone, while the recent Desmids are exclusively fresh-water forms? In allusions to these fossils this fact seems to have been generally overlooked.

The close analogy existing between the structure and mode of growth of the Desmidiaceæ and that of other undoubted unicellular Algæ became evident with the rapid improvements in the instruments of observation. Not so, however, with the Diatomaceæ, for although the opinion is now almost universal among those most competent to decide the question, that they are truly vegetables, this conclusion was long opposed by able writers, and even now is by some authorities strenuously disputed. With the majority of observers I will assume their vegetable nature, and endeavor to describe the most important features in their structure and mode of growth.

The Diatoms (from *dia* and *temno*, to cut in two) are, like the Desmids, unicellular Algæ, consisting essentially of two plates, concavo-convex, bacillar, hemispherical or depressed, connected together by a band or hoop called the "connecting membrane," applied to and coinciding with the circumference of the valves, and enclosing within a coloring matter, which, unlike that of the Desmids and most true plants, is of a yellowish or orange-brown color. The form, structure, and marking of these valves are often very complex as well as beautiful, and are of vast importance in the classification of these organisms. As to *form*, the Diatoms present an infinite variety of size and outline. Mathematical curves of the most exquisite perfection, combinations which the designer would grasp with eagerness in the planning of his models, surfaces adorned with the most unlimited profusion of style and ornamentation, are everywhere presented. They may conveniently be arranged under two great heads; first, of the forms more or less linear or bacillar in outline, including most fresh-water species; and, secondly, those which are discoid, almost solely marine. This division is

not an accurate one, many linear forms being marine, and a few discoids fresh water, but the distinction is a convenient one, and sufficiently characteristic to apply to the majority of cases.

Among the forms whose general outline is linear, we have those which are straight and free (such as *Nitschia*, Pl. 13, fig. 8), those whose "frustules," as the separate individuals are termed, are adherent by the base, and which produce fan-like clusters, or even star-shaped aggregations (as in *Synedra*, fig. 33; *Asterionella*, fig. 17; and *Licmophora*, fig. 20); those with the individuals adherent by the sides, and producing lengthened filaments (fig. 18), which if one end of the cell be smaller than the other, will give rise to spirals (as in *Meridion*, fig. 12), or again lying free with others of its kind in a sort of gelatinous envelope or cushion (as in *Mastogloia*, fig. 19, *Encyonema*, etc.), or adhering by alternate corners and producing zigzag chains (as in *Diatoma*, fig. 16; *Grammatophora*, fig. 30; *Tabellaria*, fig. 13); or, lastly, not included in either of the above divisions, but still having a certain general resemblance to the typical straight line (as *Cocconema*, *Gomphonema*, etc.). These are by no means natural or scientific divisions, but aid in fixing in the memory their characteristic shapes. Between each other and the second great class of circular or discoid forms, there is every variety of gradation, the one insensibly passing into the other. The latter, or discoid forms, which, as I have said, are mostly but not exclusively marine, are also characterized by even greater variety of form and outline, often exceeding in beauty of conception and in delicacy of execution the most elaborate works of human ingenuity. As a general rule the surface of their valves is more or less broken into numerous dots, depres-

sions, or elevations, and frequent areolations, circular or hexagonal. This is a very general character of all the Diatomaceæ, and is due to the deposition of layers of silex variously disposed within or between the different membranes which enclose the cell, and which, remaining persistent and retaining all their delicate sculpturing after the removal of the organic contents, are the portions which become fossil and which, even in recent gatherings, are the chief features used for the discrimination of the species. Frequently several different modes of ornamentation are visible upon the same shell, and are possibly situated in its different layers. The exact position, and the number of such membranes, and the nature of the markings, are still subjects of discussion among the students of these forms. The presence of this silex, however, is the fact of most interest in their structure, whether they be regarded in a strictly scientific, or in an economical point of view.

Among the discoid forms may be enumerated those with a circular outline, and circular or hexagonal areolations (such as *Coscinodiscus*, Pl. 13, fig. 34; *Craspedodiscus*, etc.), those with a circular valve divided into partitions by radiating lines (as *Arachnodiscus*, fig. 29), those with a simple disk, but united into continuous filaments (as *Podosira*, fig. 25; *Melosira*, etc.), those with a more or less circular outline, but with the surface projecting into spines or processes which seem to connect adherent frustules (as in *Biddulphia*, fig. 31; *Eupodiscus*, etc.); or, lastly, of forms not truly circular in outline, but really modifications of the circle, and approaching that shape by insensible gradations (as *Triceratium*, fig. 27; *Amphitetras*, fig. 36; *Campylodiscus*, *Surirella*, etc.). As a rule, the circular forms may be compared to

tolerably flat thin pill boxes, or, still better, to a common watch. One genus, indeed, the *Hyalodiscus*, when magnified over 2,500 diameters, bears a striking resemblance to the covers of an engine-turned watch, two sets of delicate dots radiating in eccentric curved lines from the centre towards the periphery, and giving to the shell, under bright illumination, a truly exquisite appearance. Some have the disks so convex as to make a nearly spherical figure, others have the surface depressed at the centre, while others again are beset around the margin with a glittering row of spear-like points. The imagination can scarcely picture a form of beauty which does not find a counterpart among these most wonderful of Nature's medallions.

The multiplication of the Diatoms, like that of the Desmids and other unicellular Algæ, takes place according to one or the other of two modes, either by simple cell-multiplication, the original frustule dividing into two which again subdivide, or else by a true generative process, and the formation of Sporangia. The first method is exceedingly common, so much so, indeed, that we can scarcely find a specimen in which the process is not just ended, or in some stage of advancement. This multiplication takes place by the gradual enlargement or widening of the "connecting membrane" before alluded to. (See Pl. 13, figs. 31 *a*, and 23 *a*.) Nearly at the beginning of this process the contents of the cell are divided into two portions, while the lining or inner membrane of the parent cell becomes doubled inwards in an annular ring about the whole circumference along the line of division. This infolding membrane continues to advance, until a nearly complete division has taken place of the old cell into two new ones, the two new contiguous

valves becoming impregnated with silex before they have become free of the connecting membrane. (Pl. 13, fig. 31 *a.*) In this way a complete septum is formed, the two new frustules often remaining enclosed within the connecting membrane, like the inner tubes in a telescope. These new cells, which in every way are the exact counterpart in size and structure of their parents, may remain thus enclosed, but more frequently are left free by the falling off of the connecting membrane. The new frustules thus formed, by the greater or less adhesion among themselves, which differs in different species, give rise to all the different forms of aggregation already alluded to. If adherent side by side, the effect is to produce a lengthened filament, either straight (Pl. 13, fig. 18), or spiral (fig. 12); if adherent only at corresponding corners, a star-shaped figure is produced (fig. 17); if at alternate corners, a zigzag chain (fig. 16). Frequently processes of greater or less size are developed at the corners, which serve as means of adhesion between the two (fig. 23). Lastly, the division may be complete, and the resulting cells remain aggregated in a spongy mass (fig. 19); or else, entirely free, swim slowly through the medium in which they live (figs. 9, 10, 28, 32, etc.).

Of the contents of the cells or "frustules," their chemical composition, changes, and internal movements, it is unnecessary now to speak. Suffice it to say, that the existence of the so-called *stomachs*, organs of locomotion, etc., which Ehrenberg asserted that he had detected in their interior, have been entirely disproved by the researches of later authors. The "endochrome," as I have already said, is of a different color from that of most plants, and is even supposed by many to be of a different chemical composition; but in most other respects their

resemblance to true plants is very marked, and as they bear the closest analogy to the Desmids, which all observers now admit to be vegetables, it can scarcely be doubted that they, too, are of the same nature.

One of the greatest obstacles to a belief in the vegetable nature of the Diatoms has always been the wonderfully curious motions which nearly all of them exhibit in their living state. This is not a merely mechanical motion, due to light or other external agents, although they share this property with other known plants, but they seem to have a certain internal principle of locomotion peculiar to themselves. They may constantly be seen swimming through the water, with a motion slow, to be sure, when we consider how much that motion is magnified, yet certainly as rapid as that of many undoubted animals among which they dwell. As a general rule these motions are simply backwards and forwards, any interposing obstacle being pushed aside, but not avoided; at other times, the motion is a slow rolling from side to side. In one species, however (the *Bacillaria paradoxa*, (Pl. 13, fig. 18), so singular are the movements exhibited, and so unlike anything that occurs either in the animal or vegetable kingdom, that they never fail to excite astonishment in those who, for the first time, behold the curious phenomenon.

Like a lengthened ribbon, crossed by numerous close and parallel bands or bars, the Bacillaria frequently attains a length of an inch or more. Hanging from some green confervoid plant, or floating freely in the water, this fragile form, transparent and lustrous as the finest spun glass, is at first quite motionless. Slowly detaching itself, however, at one end, a strange activity will soon become apparent throughout its entire length. Each

glassy bar takes upon itself an individuality, and though still connected with the rest, moves as with an impulse of its own. The middle bar alone is motionless. Those on either side slide gently on the last, the one to the right, the other to the left, with clock-like regularity. The movement of the first is the signal for all the rest. Each in turn slips quickly along his neighbor's side, until from a long and ribbon-like band, we now have a séries of glassy steps, each crystal bar resting slightly upon that below it. But the change is transient. When the whole series has thus unfolded, as it were, it begins to slowly recoil again. Each plant or bar resumes its former place, and the ribbon-like band again hangs motionless from leaf to leaf.

The cause of these motions has been severally assigned to the action of minute vibratory cilia, to an undulatory motion of the outer membrane, and to the mechanical effects resulting from the absorption or discharge of water. The subject, however, is one which yet remains in great obscurity.—*To be concluded.*

EXPLANATION OF PLATE 13.

Figs. 1–5. DESMIDS,—1 and 3, Euastrum; 2 and 6, Xanthidium, resembling fossils found in flint; 4, Micrasterias; 5, Closterium.

Figs. 7–21. DIATOMS.—*Fresh-water.* 7. Navicula; 8, Nitschia; 9, Stauroneis; 10, Pinnularia; 11, Eunotia triodon; 12, Meridion vernale; 13, Tabellaria flocculosa,—*a*, front view, *b*, side view; 14, Cyclotella Kützingiana,—*b*, side view; 15, Acnanthes; 16, Diatoma flocculosum; 17, Asterionella; 18, Bacillaria paradoxa; 19, Mastogloia; 20, Licmophora; 21, Odontidium.

Figs. 22–36. DIATOMS.—*Marine Forms.* 22, Amphiprora; 23, Amphitetras, forming a zigzag chain,—*a*, a frustule about to divide into two, *b*, two frustules newly formed but not yet separated, the "connecting membrane" having fallen off; 24, Asteromphalus, a beautiful deep-sea form, taken from below 2,000 fathoms in the sea of Kamschatka; 25, Podosira; 26, Navicula didyma; 27, Triceratium; 28, Nits-

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chia; 29, Arachnoidiscus; 30, Grammatophora; 31, Biddulphia,—*a*, two frustules, still enclosed by the "connecting membranes," *b*, "connecting membrane," widening previous to self-division; 32, Pleurosigma; 33, Synedra; 34, Coscinodiscus; 35, Triceratium; 36, Amphitetras.

The forms are not accurately drawn to scale, but are for the most part magnified about four hundred diameters.

A BOTANICAL EXCURSION IN MY OFFICE.

BY PROF. HORATIO C. WOOD, JR., M. D.

PROBABLY most of the readers of the NATURALIST have, at some time or other in the last five years, owned, or at least been interested in aquaria. If what happens in Philadelphia may be taken as an index, many such observers of water-life have been pestered by a minute growth, which seems to flourish alike on plant or stick, on the living and dead. Last winter and spring the writer of this article had a small aquarium, which, as far as plants were concerned, was stocked chiefly with the *Ceratophyllum*, or hornwort, which, as is well known, possesses a vast abundance of finely dissected, twig-like leaves. Glancing one day at his water-garden, he noticed on these little cylindrical divisions a fine hazy fringe, scarcely to be perceived except by allowing the light to shine through the vessel containing the plant. Now this fringe, this nebulous garment clothing the hornwort, was the minute growth alluded to, which, though not strictly parasitic, not feeding on the plant to which it is attached, is, in most cases at least, associated with a sickly state of the larger plants, and certainly detracts from their beauty when viewed with the unaided eye, as in aquaria. But let us take our forceps, break off one

of these little twigs, place it on a glass slide, put over it the cover, and carry it to our microscope. For this examination, a power of about one hundred diameters is the most satisfactory, say an $\frac{8}{10}$ or $\frac{2}{3}$ objective. Let me place the object on the stand, adjust the light and focus, and now peer through the eye-glass, and lo! our scarcely perceptible prize starts into view as a huge subaquean forest, or rather cane-brake, with great leafless stems; here and there more sparse and open, here and there more close and impenetrable.

A wonderful land is this we have entered upon,—a land more strange than ever was dreamed of by Eastern romance. It has not only a vastly diversified flora, but also myriad animal forms.

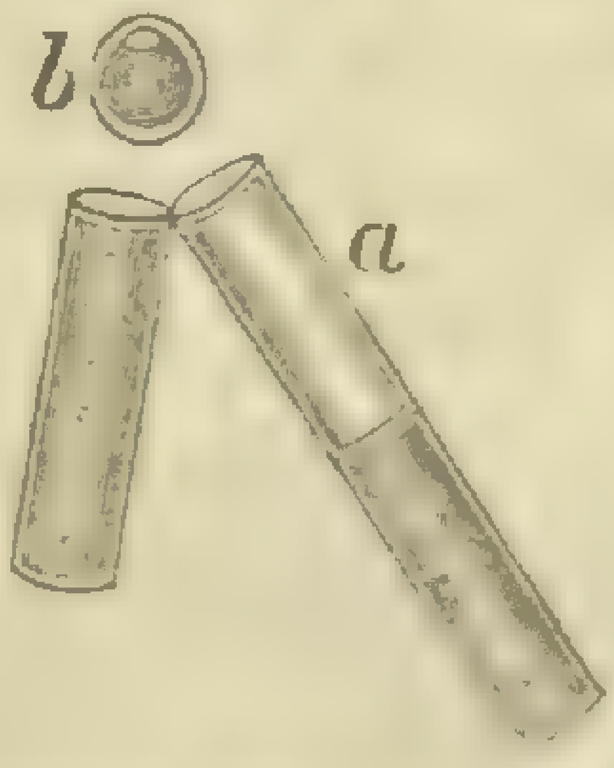
If time and space would allow, we might watch the little groups of Vorticellas, making, by their rapidly-moving cilia, numerous whirlpools, which, to many of the inhabitants of the drop of water, are as fearful as ever maelstrom was to ocean wanderer; for down in the centre of each miniature whirlpool lurks their destruction, towards which the current resistlessly forces them when once within its grasp. Perhaps a huge many-armed hydra might be found lurking in the thickets, or the jelly-like, formless mass of an Amœba writhe itself into ever-varying shapes before us. But we must pass by rotifers, infusoria, entomostracans, arachnids,—all the marvellous animal inhabitants to be seen,—as well as the various diatoms, desmids, and other plants, save the species which is the predominant feature of the scene we have been looking at.

The secret of the intense interest excited by these microscopic objects in any naturalist who has once fairly entered upon the study of them is the fact, that here we

are brought, as it were, face to face with the greatest of all mysteries—*life;* here we see it in its simplest expression, and are able to watch all its processes, to perceive every movement, and, in fact, come as close to the force or forces which constitute life, as the chemist in his laboratory, or electrician in his study, to the forces whose action they investigate. The study of infusoria or of microscopic algæ is not merely, as in most natural history studies, one of form and relation, but rather is it the study of life.

The scope of this paper is not such as to allow anything more than an entrance into this subject just far enough to glance at the beautiful prospect beyond. The plant itself is one of those simple forms which prefigure some variety of vegetable tissue, as seen in higher plants. It is composed of a number of cells placed end to end (Fig. 1), so as together to form a filament.

Fig. 1.



Zoöspore escaping, still surrounded with gelatinous material. *a*, cell in which it was formed; *b*, zoöspore, surrounded with its primary gelatinous envelope.

Let us pause a moment here to learn what a vegetable cell is, if we do not already know. The microscopist has given the name of *cell* to little vesicles, closed spheres, cylinders, or some other hollow forms, which his investigations have taught him, compose the animal and vegetable creation. Mayhap the reader of this article has, at some time in his summer saunterings, sat beneath a giant oak, and, peering into the water rippling at his feet, watched the little green mosses waving in the stream; or, stooping to pick up a pebble, has noticed the dark lubricous stratum on its surface. How different do these seem from the tree that shades him! Yet in their essence

they are the same. That scarcely perceptible speck on the quartz is a vast assemblage of little plants, composed each of but a single vesicle or cell; whilst the oak that towers above is nothing but a vast assemblage of such cells united into a single plant.

All plants, from the lowest to the highest, then, consist of cells, which are essentially the same throughout the whole vegetable kingdom. Let us take a cell of the plant before us, and examine it as a specimen of the vegetable cell.

In the first place, on its exterior we find a dense, but transparent coating, resistant to external force, and apparently structureless. Examine it with our highest powers, and still it is structureless, a homogeneous, perfect membrane, without pores or any interruptions whatever. Yet it is easy to prove that water and various fluids can pass through it. Place the cell in a dense syrup, and the water will be drawn out of it so rapidly, that the contents will shrivel up. Again; the contents of the cell are, as we shall know directly, composed largely of a substance which shrinks and hardens under the action of various substances. Put a plant in diluted acid, or strong alcohol, and see how the contents gather themselves together; or surround it with a solution of iodine, and see how soon the change of color in the most central part betrays the presence of that element. Such experiments as these prove that although the cell wall is absolutely homogeneous, destitute of all pores, yet fluids can pass through it. You see how, in the very onset, we are led into one of life's processes, *osmosis*, as it is technically called; but we must pass it by.

Let us try a little microscopic chemistry. Put a filament on a clean slide, and allow a watery solution of

iodine (dissolved by means of iodide of potassium) to flow round it. Then add a drop of sulphuric acid, and see! the transparent, colorless outer wall has become of a decided bluish or purplish tint. This is the test for *Cellulose*, a substance identical with starch in its constitution, of which the outer wall of *all vegetable cells is composed.* When a plant wishes to store up its material for future use, it throws it into the form of little insoluble granules (*starch*), which are deposited in the cells in various storehouses,—sometimes underground stems, sometimes roots, sometimes leaves, sometimes other parts are selected. When the plant wants to move its material from place to place, it converts it into *dextrine*, which is soluble, and therefore capable of being transported. But when the material is to be finally disposed of, stored away, then it is made to take the form of *cellulose.*

Within the cell, lying immediately against the outer wall, is a thin, gelatinous, scarcely perceptible layer, which is colored brown by iodine, and coagulated and rendered more apparent by alcohol, sulphuric acid, and various reagents; this is the so-called *primordial utricle*, an albuminoid, homogeneous mass, in which much of the life-activity of the cell resides. Inside of this is a semifluid mass which is very complex in its constitution, and different at different times. The essential parts of it are *protoplasm* and *chlorophyl*. The former of these is probably identical with the primordial utricle, and shows its wonderful formative power. Chlorophyl is the green coloring matter of plants. It is chlorophyl containing protoplasm, which alone stands between all animate creation and death by starvation. For it is this alone which possesses the marvellous, almost creative power of seizing the inorganic elements and compounds of the earth and

air, and changing them into organic principles capable of life. But to do this, *light* is necessary; it is only by the aid of that force that the chlorophyl can awaken into life the clod and breeze. Without light,—

> "The world were void,
> The populous and the powerful were a lump
> Seasonless, herbless, treeless, manless, lifeless,
> A lump of death,—a chaos of hard clay."

Somewhere in the protoplasm is generally to be found a spot of great refractive power, the *nucleus;* in the cell before us mayhap we can find it close to the wall, maybe it is absent. The nucleus is nothing more or less than a little solid protoplasmic ball. Much importance is assigned to it by most authorities, and in fact it, when present, plays a very important role in the life-history of the cell. But in these algæ it is often absent, and the truth seems to be, that the primordial utricle, nucleus, and general protoplasm are identical in constitution and formative powers. In other words, that they are different manifestations of the same substance.

Now let us place one of our filaments under a high power and examine it closely. Under a $\frac{1}{5}$ objective, we will plainly perceive a very curious phenomenon going on inside of some of the cells. Notice among the general semifluid contents a number of minute dark specks or dots; these are minute granules of protoplasm. See! they are in active motion,—some are busy travelling from one end of the cell to the other, and all along it they are passing one another. But the mass of them are collected in two groups at the ends of their cells; all of them busy bustling about in all directions amongst themselves, reminding one of a hive of bees about to settle.

We have thus in our little plant had a sight of a process, which, variously modified, is probably present in all

vegetable cells during some period of their active life. To these protoplasmic movements the name of *Cyclosis* has been given. Among the higher plants, the hairs of the stamens of the *Tradescantia Virginica*, or Spider-wort, are favorite subjects for the study of Cyclosis.

It is well known, that, in our ordinary flowering plants, there are two distinct methods of continuing the species. In the one case, there is a peculiar system of organs provided, which are in a measure antagonistic to the growth of the individual, and which produce seed, little bodies capable of renewing the life of the species; in the other case, certain portions of the ordinary nutritive organs of plants are set apart to reproduce the species. Thus in our common potato, by means of the flower, with its stamens and pistils, seed is produced; but, at the same time, portions of the underground stem become store-houses of vital force and starch, to serve as material out of which that force may obtain its building stores. Other familiar instances of this changing of the destinies of a part, are seen in the so-called bulbous roots, in the little aerial bulblets of the Tiger-lily,—all of them nothing but ordinary leaf-buds gorged with nutritive materials, and made the depository of vital force, in order to survive the death of the individual, and perpetuate the species.

As it is in the highest plants, so do we find it in the lowest. Unity in diversity seems to be the motto of creation; the broader we extend our studies, the oftener will we find the same ideas outcropping in different forms.

In the little confervoid growth under consideration, then, there are two distinct plans by which the species is perpetuated. The first is by a setting apart of certain ordinary nutritive parts of the plant, the other the specialization of a peculiar set of organs.

Let us study the former of these. Imagine our plant under the microscope, just as some one or more of its cells are to be sacrificed for the production of a new life. Watch that cell. See the endochrome, or green contents, gathering itself by an imperceptible motion into a condensed mass at the distal end of the cell. Now a separation is evidently taking place between this cell and the next at its distal end. Slowly they part from one another, remaining attached at one corner, so as to open like a hinge until the sundered parts, instead of being in one continuous line, lie side by side more or less parallel to one another, and a free opening is left at the end of the cell. Slowly the mass of endochrome continues to move, so slowly, that, even with a very high power, the motion is imperceptible. Perchance the outlet seems too narrow for it, and, in twisting itself out of it, the plastic mass assumes various shapes constricted in the middle where the orifice is. It continues, however, to advance, until at last it is out of the cell in the free ocean around it. (Fig. 1.) It now recovers very quickly its shape, and is a bright green, globular or oval mass, with a little transparent spot at one end. As I have seen the species under consideration, this little ball is at first coated with a transparent gelatinous material, which rapidly dissolves off in the water. Let us keep our eye still fixed on the ball. See! the coating is nearly gone, and, is it true? the little ball begins to rock without apparent cause. Now it rocks faster and faster, and now it is gone out of the field like an arrow. Here it comes back, moving hither and yon, now very rapidly, now with a slow laterally rolling

Fig. 2.

A zoöspore shortly after germination, of a species of Œdogonium growing in springs around Philadelphia. *a*, root-like processes growing at the ciliated end of the zoöspore.

Fig. 2, *e*

Zoöspore killed to show its cilia.

motion. The plant has given birth to an offspring possessing apparently the peculiarly animal power of spontaneous motion. Let us now place a little solution of iodine or laudanum so that it will come in contact with our little moving body, and in a moment motion ceases, —we have killed it!

Let us now carefully arrange our light, illuminating the stage a little obliquely, put on our $\frac{1}{5}$ objective, adjust it for the glass cover, and see if we cannot discover the cause of the motion. Do you not see a circle or crown of long, lax, streak-like particles attached around the bright transparent space before spoken off. These are *cilia*, fine threads of condensed protoplasm. If during life one of these motive bodies is placed in a liquid containing very fine particles, as a dilute solution of India-ink or gamboge, and watched, constant currents will be seen to be produced by these cilia, which are in such rapid motion that they cannot be otherwise detected. It is, then, by virtue of the constant lashing of the cilia, that the little body moves, just as a boat moves by means of the scull. The movement of the cilia themselves is not a voluntary one; it is a form of the protoplasmic movements, of which cyclosis is one type.

Let us take our motive body, killed by means of the iodine, and add sulphuric acid to it; if cellulose be present, a bluish or purplish color will be produced. But there is none. In other words, our little body is composed simply of protoplasm and chlorophyl; it is a cell without a wall. To these moving bodies the name of zoöspore is given. If you watch a living zoöspore, in a little while its motion ceases, its cilia drop off, and it surrounds itself with a cellulose wall.

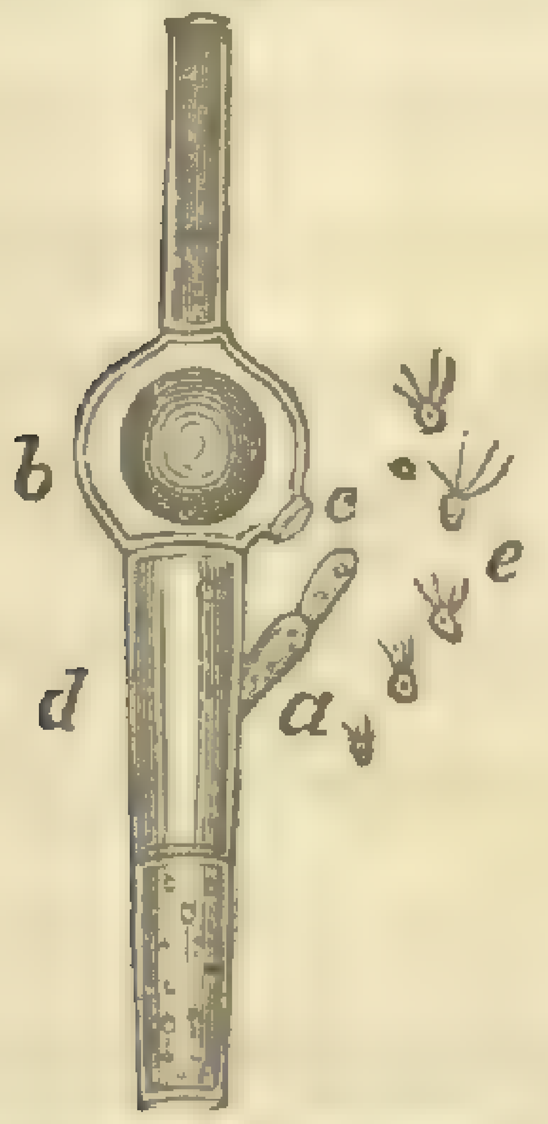
In most plants allied to the species under consideration,

from the position of the cilia (Fig. 2) there grow, during this process of germination, little root-like processes which attach themselves to some anchorage, but I have not been able to detect them in the aquarial inhabitant. The cell, having acquired a wall, and thus perfected itself, now begins to elongate; by and by it undergoes cell division, and thus divides itself in its length into two cells, which grow and divide, and by repetitions of this process, the filament is formed, that which we noticed at first. This plant belongs to the genus *Œdogonium*, the species of which are arrangeable into three sets; first, those in which the single filament produces both male and female organs; secondly, those in which male and female organs are produced in distinct filaments; thirdly, those in which the female filaments produce, besides the regular zoöspores, others which, in germinating, grow into peculiar dwarf plants, in which are formed the male germs. These three sets are known respectively as *monœcious*, *diœcious*, and *gynandrosporous* plants; the term androspore being given to the zoöspore, whose function is to grow into the little dwarf male plant. The Œdogonium of the aquarium belongs to the gynandrosporous division.

Besides these zoöspores the Œdogonia produce, by means of a specialized reproductive system just alluded to, a spore or seed which is known as a *resting spore*. In our plant this is produced as follows: a cell in the main filament begins to enlarge, and, at the same time, a communication is opened between it and the next proximal cell, whose endochrome is emptied into it. The two consolidated endochromes now contract themselves into a roundish ball in the swollen cell, the sporangia or spore-case. About this time several of the *androspores* (Fig. 3) attach

themselves generally on the emptied cell (Fig. 3), sometimes on the sporangium, and soon grow into a peculiar two-celled little plant. The base of the first of these cells is enlarged into a roundish, disk-like part, which is attached to the anchorage, and is known as the *foot.* It is the distal of the two cells in which are formed the male germs, the so-called *spermatozoids.* These are little bodies very similar to the zoöspores, but much smaller, and almost destitute of color. They are similarly ciliated, and have similar powers of locomotion.

Fig. 3.



A portion of a female plant with its spore just fertilized, and a dwarf male plant on the emptied cell. *a*, dwarf male plant; *b*, sporangium with its contained spore; *c*, opening through which spermatozoids enter; *d*, cell whose endochrome has been used in making the spore; *e*, spermatozoids (out of proportion in regard to size).

About the time that they are perfected, there is formed a lateral opening in the proximal or lower part of the sporangium of the resting spore. Through this orifice one or more of these spermatozoids enters and impregnates the endochrome, which contracts itself still more, and matures into the fully formed resting spore. During its maturation its green color changes into a reddish-brown, and it acquires two coats, the outer of which is very thick and provided with a curious spiral band or marking. (Fig. 5.)

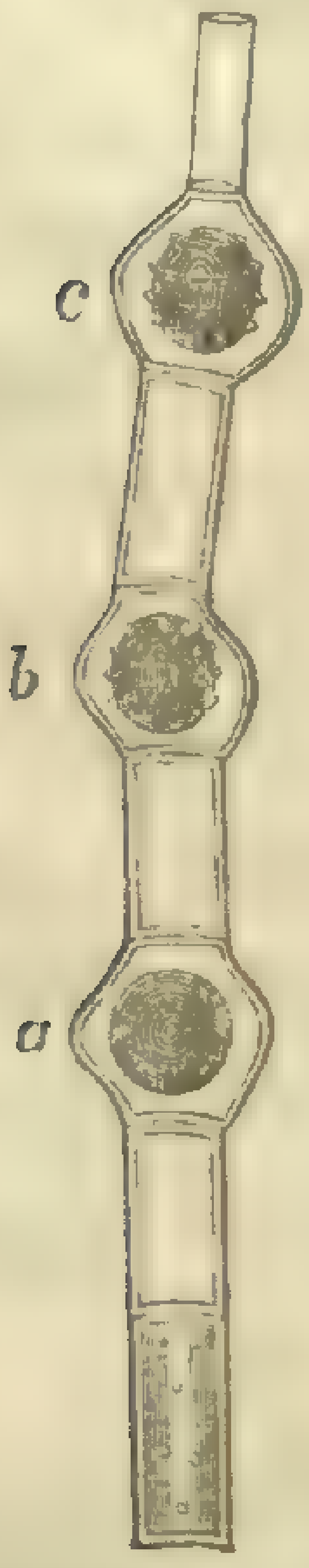
Fig. 4.

Young dwarf male plant magnified about 1,000 diameters. *a*, foot; *b*, main body of the primary cell, with granular protoplasm in very active motion,—direction of the currents shown by arrows; *c*, newly-formed cell, very delicate, scarcely perceptible above.

The exact way in which germination of the resting spores takes place in the genus

Œdogonium, has never been determined. In the allied genus *Bulbochæta*, the resting spore finally breaks up into zoöspores, which grow into the plant in the same way as other zoöspores.

Fig. 5.

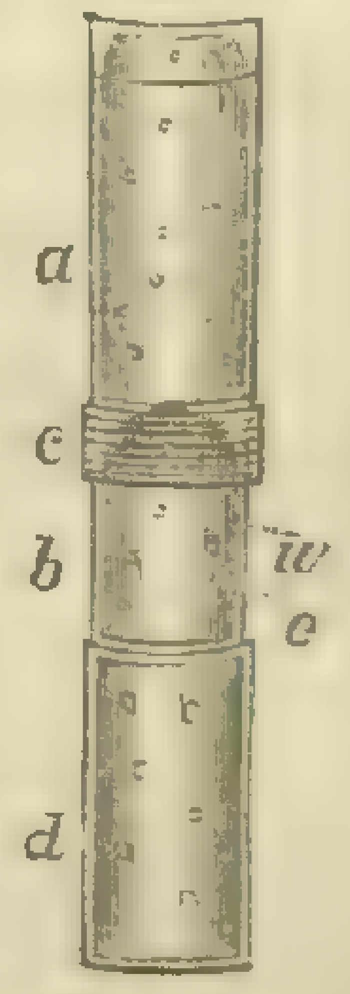


Portion of female filament with spores. *a*, immature; *b* and *c*, mature, showing spiral band.

If we examine our filament closely, we will find it terminated by a long, exceeding delicate, bristle-like hyaline point, composed of cells whose walls are so delicate, as to be scarcely perceptible with very high powers, and at the end apparently consisting simply of primordial utricle, though I confess never to have accurately determined this by micro-chemical tests. Again, if we look at some of the large cells of the filament closely, we will find near their distal end one, two, three, or more streaks surrounding them like so many collars. Let us look still more closely. Why! such cells evidently have their wall beyond the first streak or line thickened, in fact bear on their upper ends little caps, as it were, the lines being in the caps. The causes of these two phenomena, the hyaline point and the little caps, are to be found in the peculiar methods of growth of the Œdogonia. The larger cells increase by a variety of *cell multiplication by division*. Cell multiplication by division is almost the only way in which all vegetable growth takes place. The process, as it ordinarily occurs, may be outlined in a few words. If a cell, about to undergo it, contains a nucleus, the first change takes place in that nucleus; a constriction can be seen encircling and increasing in depth, until the nucleus is divided into two. When this has taken place, a doubled reflection from the primordial

utricle grows inwards, and, dividing the protoplasm and contents more and more completely, finally meets in the centre, and the single cell has been divided into two, each half of the original size. These small cells now increase in size by an interstitial growth of their cell-wall until they reach their full size, when, perchance, the process recommences. Sometimes a globular cell will divide into three, four, or more parts, but the process is essentially the same. In *free cell formation*, the protoplasm of a cell condenses into a varying number of little masses, which, whilst lying free in the interior of the mother cell, secrete, each around itself, a cellulose wall. In this way is formed a number of perfect cells, enclosed in, but independent of, the original cell, by whose dissolution they are finally set free.

Fig. 6.



Two cells taken from a species of Œdogonium growing in the neighborhood of Philadelphia, not the aquarial one. *a*, cell in which division is about to take place above.—the dark line or streak showing: *b*, young cell bearing the remains of old cell (*c*) on it: *e*, its endochrome; *w*, its newly formed cellulose wall: *d*, old cell from which it has separated.

But let us return to our little plant and observe together a cell about to divide. The first noticeable change is the appearance of a dark streak around the cell near the distal end. At the position of this streak outgrowths take place from the primordial utricle as just described, and divide the old cell into two parts, the upper being much the smaller. (Fig. 6.) Watching the dark streak just spoken of, in a little while it begins to widen into a trench, and still continues to widen; the upper smaller division is growing by an elongation of the primordial utricle at the line of separation of the two parts. As the primordial utricle grows, it bears the old cellulose wall, like a cap upon its end; and, when it secretes its own proper cellulose wall, the

latter is of course inside of this. When the newly formed cell has attained its full size, it recommences the process again. The dark line now appears just below the edge of the old cap, and gives origin to the edge of the second cap, that of the former remaining apparent as a dark line. Again the process is gone through, and a third cap is formed, the margins of the first and second persisting. And so repetition after repetition, until a cell is formed bearing on its end a cap which is ringed with half a dozen dark lines, and composed of as many layers of cellulose. The dark rings of course mark the edges of the successively cut off ends of cells. If there be six such lines, cell division has taken place six times since the original was formed. (Fig. 6.)

Fig. 7.

End of a filament, showing hyaline point.

Fig. 8.

Perfected spore of the species from which Fig. 6 is taken.

Whilst the cells near the base are thus lengthening the filament by their increase, the end cell seems to grow by a sort of out-pushing of the primordial utricle from the central part of the fore end. This makes a little cylinder, which is soon cut off from its parent cell by a partition, secretes a cellulose coat, and then pushes out a new shoot from its free end, just as itself was formed. By a repetition of this, a series of cells is made, each of which is smaller than the proximal one; and, finally, the filament is drawn out into a fine hyaline point. (Fig. 7.)

THE QUADRUPEDS OF ARIZONA.

BY DR. ELLIOTT COUES, U. S. A.

(Concluded from p. 400.)

FAMILY *Hystricidæ*, the Porcupines. The yellow-haired Porcupine (*Erethizon epixanthus*) is a large and handsome species, which replaces the common one in the Western regions. Besides being somewhat larger than the last, there are differences in the color of the hair and quills, and some peculiarities of the cranial bones. I believe nothing has been observed regarding its habits whereby it differs from the Eastern species (*E. dorsatum*). It is particularly abundant along the Colorado Chiquito River, and nearly all our explorers have obtained one or more specimens in that vicinity.

Family *Leporidæ*, the Hares. Two species of the family are very abundant, and generally distributed over the Territory. These are the Great "Jackass" Hare (*Lepus callotis*), and the Sage Rabbit (*L. artemisia*). Certain other species, as *L. Californicus*, in the Colorado Valley, or *L. campestris*, in Northern Arizona, may possibly occur; but the two first named are the only common and characteristic ones.

The Jackass Hare includes in its extensive range nearly all the great Western prairies extending into Texas and New Mexico, and is, in places suited to its wants, a very abundant animal. In some desert regions it and the Coyoté are almost the only animals of any size to be found, and it is difficult to imagine how they derive nourishment from such forbidding localities. It must feed largely upon sage-brush, grease-wood, kreosote-plant, young mimosas, and the like; for these constitute the main features of

the flora over large tracts, where grasses and succulent herbs are mostly wanting. Its flesh is said to derive a bitter taste from this sort of food; though I have eaten these hares from various regions without noticing any difference in their quality. At Fort Whipple, the species is very common the year round, and almost every sort of locality is frequented by them, though they chiefly affect grassy meadows and open glades, interspersed with copses, or clumps of oak trees, or patches of briery undergrowth. The gulches or "washes" as they are called, leading out of mountain ravines, and thickly set with grease-wood (*Obione canescens*), are favorite resorts. They feed much upon this plant; and by their incessant coursings through patches of it, they wear little intersecting avenues, along which they ramble at their leisure. When feeding at their ease, and unsuspicious of danger, they move with a sort of lazy abandon, performing a succession of careless leaps; now nibbling the shrubs overhead, now the grass at their feet. They are not at all gregarious, though peculiar attractions may bring many together in the same spot. They do not burrow, but construct a "form". in which they squat. I do not think these are permanent; but rather that they are extemporized, as wanted, in some convenient bush; though the case may be different during the season of reproduction. It has been stated by some authors, that only two or three are produced at a birth, which I know to be at least not always the case, having found as many as six embryos in the multipartite womb of a pregnant female. In the latitude of Fort Whipple the young are brought forth in June.

Although so timid, like all hares, this species will admit of a very close approach when it fancies itself hidden

in its form; though it hardly squats so pertinaciously, nor is it so easily concealed as the little Sage Rabbit, on account of its size. Trembling at heart, yet with motionless body and eyes intently regarding the intruder, it sits all doubled up, as it were, the head drawn in, and the long ears laid flat upon its back, until one may almost touch it, when, with a great bound, it straightens out, clears the first intervening bush, and is off like the wind. It has a long swinging gallop, and performs prodigious leaps, some of them over bushes four feet high; now in the air, its feet all drawn together and down stretched; now on the ground, which it touches and rebounds from with marvellous elasticity. It will course thus for a hundred yards or so, and then stop as suddenly as it started; and, sitting erect, its long wide open ears, vibrating with excitement, are turned in every direction to catch the sound of following danger. The eye and hand of the sportsman who would cut short the first rush of the Hare must be quick, or he will be more likely to behold only a "rear elevation" of his game than to see it lying upon its side in the agonies of death, playing the prelude to its last appearance, in the culminating scene of its brief life's drama.

The skin of this species is very thin, tender, and easily torn, and nearly worthless for any practical purpose. After parted with by its owner, it is only fit for a naturalist to puzzle over, in the attempt to determine its species. In the regions where I studied the animals, there is no appreciable difference in color, between summer and winter pelages. They are always yellowish fulvous above, grizzled with gray, dusky, and black; and dull white below, tinged with fulvous on the throat. There is a longitudinal stripe of pure black on the rump, and ex-

tending on the upper surface of the tail; the under surface of which, as well as the surrounding parts, are white. The long ears are mostly grayish, or slightly fulvous, their posterior margins pure white, and their broad ends pure black for an inch or more. This parti-coloration heightens the conspicuousness which their size alone would give them.

The Sage Rabbit (*L. artemisia*) is as abundant in Arizona as the Jackass-rabbit; and, like the latter, has an exceedingly extensive range throughout the West, from the Missouri region into Mexico, wherever the sage-bush, and other desert shrubs are found. It seems rather to avoid rich, grassy, and well-watered regions, and to take up its abode in the most sterile and desolate localities. Besides ordinary desert tracts, it shows a fondness for rocky, broken, and precipitous places, such as are usually shunned by the larger species, though the two are often found side by side. It burrows in the ground, and also lives under rocks, or in the crevices between them. It is a squat, bunchy little species, and its gait differs greatly from that of the hare. It runs close to the earth, and instead of bounding over obstacles, scuttles around them with great agility. It is quite as difficult to shoot as the Jackass; for although slower of foot, yet it runs in a more tortuous and zigzag course. It squats so pertinaciously in its hiding-places, that a small bush may be kicked several times before it will come out. It may not be generally known that this species, at least in some localities, changes its colors considerably in winter. At Fort Whipple I procured one in January, whose fur was very long, thick, and soft, and without a trace of the brownish or fulvous so conspicuous in summer. It was pretty much all over of a clear mouse or steel gray,

which, on various parts, particularly the belly and limbs, passed into white, more or less pure.

Order *Ruminantia*, the Ruminants. Both naturalists and hunters distinguish two species of Deer in Arizona, called the Black-tailed and the White-tailed. Of these the former is by far the most abundant and characteristic; although, judging from accounts formerly given of it, it has considerably decreased in numbers owing to the persecution to which it is subjected so constantly from both the native tribes and the white settlers. It is the *Cervus macrotis* of Mr. Say; and is also called the "Mule Deer," from the length of its ears. A novice, on seeing it for the first time, running directly from him, would hardly think to call it "black-tailed," but rather the reverse. The black exists only on the upper surface of the tail, and near the end; and, as this member is ordinarily elevated and vibrated from side to side as the animal bounds off, only the white of the under surface and neighboring parts is exposed to view. This deer forms no small share of the food and clothing both of the Indians and white settlers. The former have as yet not generally obtained fire-arms, and in the chase resort to a peculiar stratagem, to be more particularly noticed in speaking of the Antelope. That their artifice is ordinarily successful is abundantly proved by the numbers of buckskins to be found in their rancherias. They possess the art of dressing them very perfectly, which is the more remarkable considering the primitive means they employ. Unlike the skins of lynxes, foxes, etc., those of the deer have the hair removed, and are dressed as cloth, to be used for a great variety of purposes besides clothing.

The horns of this species differ somewhat in configuration, though not materially in size, from those of the Vir-

ginian, or of the Columbian Deer. At their roots they are corrugated and nodulated for a short distance, when a small curved basal snag is given off. Near the middle they fork into two about equal branches, being widened and flattened just at the point of divarication. Each of these branches is again dichotomous not far from its middle, one of the terminal forks being ordinarily larger than the other. The whole amount of curvature of the main stem of the antler is rather less than in some other species. The horns are shed in the spring, and the new ones are in the velvet during the great part of the summer. By October, both sexes have finished changing their light coarse summer vesture for the softer and thicker winter coat, which, for some time after the change is completed, is extremely sleek and glossy. Its color is darker than it is in summer, being chiefly mouse-gray, finely waved or annulated with lighter and darker shades. In summer, there is much of a brownish or even fulvous tinge on many parts. The fawns are brought forth in June or July, either one or two at a time. They are at first of a light reddish-brown,—whence our familiar term "fawn-color,"—beautifully spotted with pure white, which is mostly disposed in straight rows.

Except at certain seasons, this deer is more apt to be found singly than in herds of any size. But frequently in the autumn two or three are seen together; and on one occasion in October, I enjoyed the rare sight of twenty or thirty feeding together in a little open glade among thick pine woods. It is not an inhabitant of open prairie land, and is but rarely to be seen in such situations. Thinly wooded tracts of country, interspersed with oaks or junipers; hills and mountain sides covered with pines, as well as those places known as "chaparrals," are its favor-

ite resorts. In warm weather, and particularly during the heat of the day, after its morning graze and drink, it is fond of repairing to the thickest brush, where it lies down, and doubtless sleeps, as at such times it may be more easily and nearly approached than at others.

I cannot positively determine the White-tailed Deer of Arizona, as I never procured a specimen. It may be a race of *C. Virginianus*, or that species called *C. Mexicanus* in Professor Baird's work, or not impossibly the *C. leucurus* Douglass. The white-tailed deer of our continent are all so closely allied, that it requires a practised eye and patient labor to distinguish them with any degree of certainty; and I believe it is a question with some, whether they all are not merely local races of one common stock.

Though the dry plains of Arizona are not frequented by deer, still they are not wanting in inhabitants among the beasts "that cleave the hoof." Over them the Prong-horned Antelope (*Antilocapra Americana*), the swiftest animal of America, runs races with the winds, making the long miles shrink into mere spans at the touch of his almost magic hoofs, whose impress upon the green sward writes down, in wild yet graceful stanzas, the "poetry of motion" which every attitude and movement of his supple form embodies. As on the land-sea of the Great Plains, so on every land-lake of Arizona he is at home; for home to him means the grassy surface of the earth, where his food is under and around him, and water may be reached by a bagatelle canter of a score or so of miles.

Every one has heard of that strange trait of the Antelope's character, which leads it irresistibly to approach any unusual object which it cannot make out, for a nearer view of the thing which so forcibly excites its astonish-

ment as to overcome its natural timidity. This remarkable curiosity is taken advantage of by hunters, to lure the animal within range, by displaying some brightly-colored piece of cloth, while they lie concealed close by, rifle in hand. The shallower the artifice, the more it seems likely to succeed; a handkerchief fluttering from the end of a ramrod, or even the hunter himself standing on his head and gesticulating with his heels, have compassed the death of many an antelope. But the Indians seem rather to surpass the white man in ingenuity, or rather in a sort of instinctive sagacity, perhaps born of necessity; and take advantage, not only of the common weaknesses of the species, but of that emotion or rather passion which at times absorbs all others, as it should, since on it depends the maintenance of the species, while the rest affect the life of an individual alone. They skin the head and neck of a buck antelope, and stretch the skin, after proper stuffing and drying, upon a light framework, the bottom of which is a hoop which fits their own heads. The horns are scraped or shaven, until they are thin and light, though still preserving their shape. This primitive taxidermy produces an imitation of an antelope's head, which at a little distance is very perfect, and the artifice is very successful during the rutting season. Concealing their bodies, the hunters expose the false mask, and imitate the motions and noises of the now pugnacious and easily excited buck. The latter, flushed with sexual vigor, hears the challenge, and sees the menacing attitudes of his supposed rival, upon whom he advances to offer battle in the cause of the object of his passion, who may be feeding quietly near by, affecting not to notice the fiery zeal of her lord. The bowstring twangs, and the feathery shaft does its bloody work for

him; while she bounds off, with terror and regret, and soon solaces her *ad interim* woe with another conquest.

This animal takes its common name from the peculiar shape of its horns, which have a single somewhat triangular prong jutting from near the base or middle of the shaft, and sometimes flattened or somewhat bent like a scroll. But the position of this prong, as well as its shape and size, varies greatly; while the length and apical curvature of the main shaft is equally variable. Scarcely any two pair of horns are precisely similar in these points, and a second species has even been characterized upon these differences alone. The curious reader will find a great variety figured in Plate XXV. of Professor Baird's work. A pair which I obtained in Arizona were of very unusual shape. They were most like Fig. 890 *a* of the plate referred to, having a very large, flat, triangular prong springing from their very bases; but their tips bent over till they pointed directly downwards, in a direction quite parallel to the axis of the shaft, which is a degree of curvature rarely seen. It is scarcely necessary to add, that the Antelope's horns are not deciduous, like the antlers of the deer, but permanent, like the horns of rams and bulls.

Arizona has woods and plains which are roamed over by the deer and antelope; but a great portion of her territory is unfitted for either of these, being upheaved into lofty mountain ranges and precipitous cliffs, or rent asunder in yawning chasms, and rocky cañons, by the rude shocks it has undergone through the convulsive violence of volcanic action. Masses of plutonic rocks are piled up in wild confusion, and black lava vomit is poured over miles of surface. In the most rugged and broken regions, rarely visited by man, or inaccessible to him, and

amid scenes that are terribly grand in their frowning desolation, is the favorite home of the Rocky Mountain Sheep (*Ovis montana*). Fearless and intrepid, fully trusting his powers, he stands in bold relief upon the edge of some abyss,—his massive horns, and towering form, and sinewy limbs clearly delineated,—the centre-piece of a great picture whose background may be a mountain or the sky itself. He stands a fitting headstone for the graves of the Titans, now quietly slumbering beneath the mighty monuments they erected to their own memory with their last convulsive throes.

The Mountain Ram has a very extensive range, which includes nearly all the elevated mountains and broken regions from our northernmost Territories into Mexico. In Arizona it has been formerly much more abundant than now, for though it still exists in the more inaccessible portions, it is rarely to be seen. But its great horns may be found scattered about the bases of nearly every cliff and precipice.

There is abundant evidence that the Buffalo (*Bos Americanus*) formerly ranged over Arizona, though none exist there now. The habitat of this "monarch of the plains" is contracting year by year, and its numbers are gradually diminishing. Like the Indian, the buffalo seems doomed to disappear before the overwhelming tide of advancing civilization, and must before long, though not in our day, be known only in history. The nature and needs of both are diametrically opposed to the spirit of the white man's progress; and in the inevitable conflict,—with them for bare existence, with us for supremacy,—they cannot hold their own. Sad spectacle, this passing away of a race of men, and of a species of animal; yet in strict obedience to an inexorable, mysterious

law of Nature, which determines the origin, duration, and ending of every form of animal life, by the operation of forces of which we can see dimly some disjointed fragments, but cannot hope to ever wholly comprehend.

THE LAND SNAILS OF NEW ENGLAND.

BY EDWARD S. MORSE.

(Continued from page 414.)

THE following species belong to a group of small snails, whose thin polished shells furnish a distinguishing character. *Helix indentata*, described in the October number, belongs to this group. We promise that those who may have become interested in these papers will find the task of identification growing more and more difficult as we proceed, as with few exceptions the shells have very few distinguishing marks, and the differences are only prominent to those who make it a study.

HELIX CELLARIA *Müller*. (Fig. 29.) The shell of this species is flattened; spire depressed, shining; whorls five, thickened within at the base; color pale horn, opaque white below. Diameter less than half an inch. Animal light indigo-blue, darker on head and tentacles. This species is not a native of this country. It has been imported from Europe to our shores through the medium of commerce. As these snails are generally confined to cellars and gardens, their eggs have probably been brought to this country on wine-casks or on the roots of hot-house plants. In a previous number we have dwelt on the extreme vitality possessed by the eggs of this family. A lady in Portland, in whose cellar

Fig. 29.

the writer collected a great many, stated that the snails annoyed her by crawling into her pans of milk. We can well imagine an enthusiastic collector delighted in being able to dredge specimens from the bottom of his coffee-cup at the breakfast table!

Another species, a true native however, though much resembling an English species, is HELIX ARBOREA *Say*.* (Fig. 30.) This is extremely common in New England, and there is hardly an old log by the roadside but that shelters them. The shell is thin, pellucid, polished, and of a brownish horn-color; whorls four to five, slightly increasing in size. Umbilicus not large; diameter about one-sixth of an inch, though occasionally larger.

Fig. 30.

HELIX ELECTRINA *Gould* (Fig. 31) resembles the last species somewhat, being of the same size, though its color is darker, and the whorls rapidly enlarge. In this latter character it resembles *Helix indentata*, though differing from that species by its dark smoky horn-color, and its open umbilicus. It occurs in damper situations, oftentimes under leaves near stagnant pools of water.

Fig. 31.

HELIX BINNEYANA *Morse* (Fig. 32) resembles *H. indentata* very much, and has always been confounded with that species; it differs in always having an open umbilicus, and the color is different, being a greenish white, while *H. indentata* is white, with a pinkish tinge. The differences are very marked in certain microscopical characters of the animal.

Fig. 32.

*The smaller figures accompanying the cuts represent the natural size of the shell.

HELIX MULTIDENTATA *Binney*. (Fig. 33.) This is one of our most beautiful species. The shell is less than an eighth of an inch in diameter, the whorls are six, very closely revolving, and at the base of the shell within are seen two or more rows of teeth radiating from the umbilicus. The shell is of a very light horn-color, and the animal is often rosy white. It is extremely rare, having been found but sparingly in Maine, Vermont, New Hampshire, New York, and Ohio.

Fig. 33.

Another charming shell, when viewed under a microscope, is HELIX EXIGUA *Stimpson*. (Fig. 34.) The shell has four whorls, banded by numerous sharp ribs, and the spaces between marked with waved lines running parallel to the whorls. The umbilicus is very wide, and the color of the shell a decided greenish white. Diameter about one-tenth of an inch. This species occurs in nearly all the Northern States; in some places quite commonly.

Fig. 34.

HELIX MINUSCULA *Binney*. (Fig. 35.) About the size of the last-named species, having four whorls; suture quite deep; umbilicus large; color white. It is common in the West, but extremely rare in the Eastern States. It is said to be very common in grass in the gardens of Cincinnati, Ohio. Rev. E. C. Bolles has recently found a number of specimens in the State of Maine.

Fig. 35.

HELIX MILIUM *Morse* (Fig. 36) is a very minute species; the whorls rapidly enlarge; umbilicus quite large. The upper surface of the shell is reticulated by slightly raised ribs, and wavy revolving lines. The under surface is shiny; color greenish-white. Diameter one-twentieth

Fig. 36.

of an inch. This little species, first described by the writer from specimens found in Maine, has since been discovered in Massachusetts, and two specimens have recently been received from California, one from San Francisco, and the other from the Sierra Nevadas, showing an unusually wide distribution.

HELIX FERREA *Morse* (Fig. 37) is slightly larger than

Fig. 37.

H. milium, and has a steel-gray tinge, and an outline more like *H. electrina*. It has been found in Maine, Massachusetts, and New York.

HELIX CHERSINA *Say*. (Fig. 38.) A very characteristic species.

Fig. 38.

The shell is conical, thin, polished, amber-colored; extremely fragile. Whorls five to six, rounded. Base convex; aperture narrow; umbilicus absent. Diameter one-tenth of an inch. This species occurs in nearly all parts of the United States, and is quickly recognized by its turreted and fragile shell.

The shells of the following group are not smooth and polished as in the majority of those just described, but many of them are coarsely striated, and a few have reflected lips. They are all quite small, and variable in form, certain species having an elevated spire, while others are quite flattened. The denticles on the tongue are not claw-shaped as in those previously described, but are notched like a saw.* All the species are very characteristic, and easily recognized.

HELIX MINUTA *Say* (Fig. 39) has a little white,

Fig. 39.

translucent shell, with four rounded whorls, the last one flaring at the aperture. Aperture nearly surrounded by a broad reflected lip. Umbilicus large. Diameter one-tenth

* The tongue of a snail was described in the first number of this Magazine.

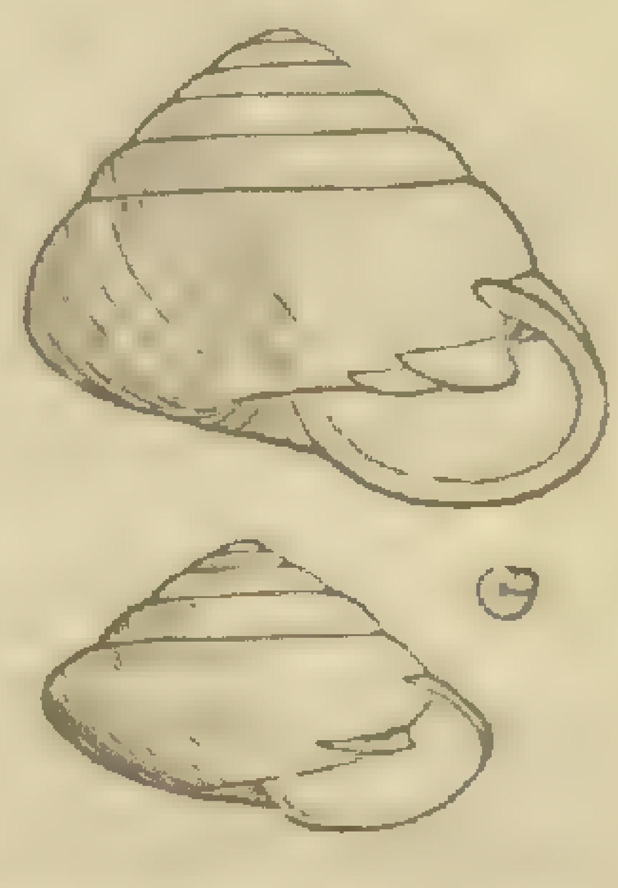
of an inch; animal whitish. This species is closely allied to *Helix pulchella*, of Europe, and by many authors is considered the same, though we believe them to be distinct. The two species have an extreme range through the northern hemisphere. It is found plentifully about old stone-walls in gardens, and in grass on banks of rivers.

Helix striatella *Anthony*. (Fig. 40.) Shell depressed, convex, thin; light horn-color. Whorls about four, with delicate oblique striæ. Suture distinct; umbilicus very large; lip thin. Diameter less than one-fourth of an inch. Animal lightish-blue above, with brownish dots. Creeping disk yellowish white. Occurs throughout the Northern States; very common in New England in hard-wood growths, and under chips and logs by the country roadside. The shell is quickly recognized by its satin lustre, and the distinct striations upon its surface.

Fig. 40.

Helix labyrinthica *Say*. (Figs. 41, 42.) Shell minute, conic, apex obtuse; brownish horn-color. Suture distinct; whorls six, with well-marked ribs following the lines of growth. Lip thickened, reflected; base flat; umbilicus small. Within the aperture are six revolving ribs, terminating some ways within the aperture. Three of these are on the body whorl, one on the umbilicus region, and two at the base of the aperture. Under the microscope, the three ribs on the body whorl are seen to be armed at intervals with numerous sharp-pointed processes, pointing towards the aperture. Diameter of shell one-tenth of an inch. Animal bluish black. Found in nearly every State in the Union.

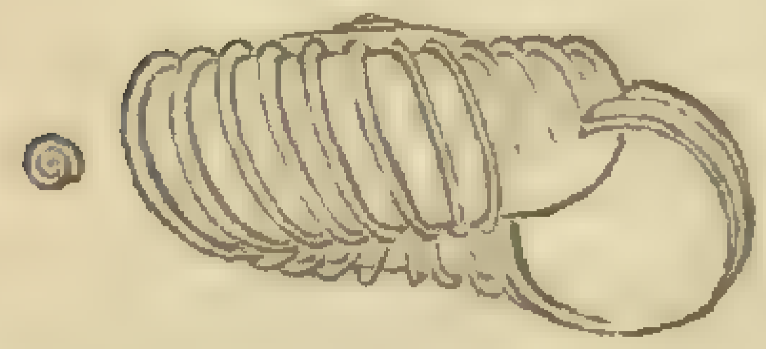
Figs. 41, 42.



This is a very characteristic species, in outline similar to *Helix chersina* described above, though differing in the coarse ribs, the reflected lip, and the peculiar teeth within the shell. The young shell (Fig. 42) is quite flat, with the outer whorl sharp.

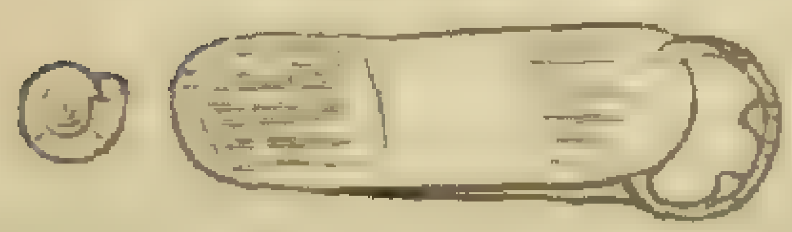
Helix asteriscus *Morse*. (Fig. 43.) Shell minute, having four rounded whorls banded by twenty-five to thirty thin transparent prominent ribs. Spire flat; suture deeply impressed; lip sharp. Umbilicus quite large; color light-brown. Diameter one-sixteenth of an inch; animal bluish-white. This little species, first discovered in Maine by the writer, has since been found on the Hudson River, N. Y.; on the northern shores of Lake Superior; Gaspé, C. E.; and in the vicinity of Salem, Mass. Rev. E. C. Bolles has found it plentifully near Portland. It is a rare shell, and seems confined to wet and boggy ground, where spruce and pine is intermixed with alder.

Fig. 43.



Helix lineata *Say*. (Fig. 44.) Shell very small, discoidal, light greenish in color. Whorls four, equally visible on both sides of the shell, having a series of raised lines revolving with the whorls. Umbilicus wide; aperture narrow, on the outer wall of which are two pairs of minute white teeth, one pair more remote. Diameter one-eighth of an inch; animal white, thread-like. Inhabits all the Northern States, though not common in the West. In New England, a very common species along country roadsides.

Fig. 44.



Helix minutissima *Lea*. (Fig. 45.) This is the smallest land shell in the country, measuring only six-hundredths of an inch. The shell is subglobose, spire

slightly elevated; below convex; umbilicus large; suture impressed; whorls four; lip sharp; color light brown. First discovered in Cincinnati, Ohio, and since found in various places throughout New England. This species is not uncommon, though owing to its extreme minuteness is not often found. The writer has separated this into a distinct genus, from the fact that the jaw is composed of sixteen distinct pieces, and not one solid plate, as in other snails. For reasons already given, the species are described under their old generic names.— *To be continued.*

Fig. 45.

REVIEWS.

Enumeration of Hawaiian Plants. By *Horace Mann.* (From the Proceedings of the American Academy of Arts and Sciences, Vol. VII., 1866.) Cambridge, July, 1867. 8vo. pp. 92.

The collection which forms the basis of this enumeration was made during a visit of over a year to the Hawaiian Islands. The enumeration, consisting of a list of the entire known flora of land-plants, with descriptions of new genera and species, is prefaced by a sketch of previous botanical explorations in these islands, with a description of the physical geography of the five islands visited by the author, and remarks on the distribution of the plants, which latter depends on the distribution of heat and moisture, and the elevation of the soil. The wet region of Hawaii, for example, extending on the eastern side of the island, from a height of 1,500 or 2,000 feet, to about 5,000 feet,* is the most heavily wooded of the group. The parts between 1,500 feet and

* "The summits of West Maui, Oahu, and Kauai, lying between the heights of 4,000 and 6,500 feet, are just in the cloud level, and, being also peaks where denudation has long been active, the soil has become somewhat impervious to moisture, which therefore remains on the surface. The region has a peculiar aspect, which is at once recognized in ascending the mountains. The only forest-tree, the ohia lehua (*Metrosideros polymorpha*) becomes stunted; the trunks are covered with a thick coating of *Mosses* and *Hepaticæ*, which retains the moisture so as to render everything dripping wet; and not more than a dozen species of flowering plants and ferns occur in the whole. Above this, on the mountains of West Maui and Kauai, there is an open tract, where the lehua, one of the largest forest-trees at an elevation of 2,000 feet, has become dwarfed, a foot or two high, in spreading clumps, but still flowing luxuriantly. In the midst of such clumps are found the violets peculiar to these regions, and in the neighboring tussocks of sedge (an *Oreobolus*) are found the few other plants, which occur here and nowhere else, to the number of eight or nine; also *Drosera longifolia*, thousands of miles from its next nearest known habitat."

the sea-level comprise comparatively few species, and but little of the peculiar vegetation. The high and dry mountain tracts, above 4.000 or 4.500 feet, are very distinct in their character and vegetation from either of the regions below. The highest lava summits are nearly destitute of vegetation.

There appear to be about seven hundred species of Flowering Plants, Ferns, and Club-mosses (including the fifty Grasses, which are not yet worked up, being still in the hands of Colonel Munro), indigenous or well-established in the islands,—a large portion of which (nearly two-thirds) are quite peculiar to them. The Lichens are catalogued by Professor E. Tuckerman, who states that "a large proportion of our knowledge, especially in the crustaceous groups [comprising those forms which grow closely, adhering to rocks or the bark of trees, and cannot be removed without crumbling up] is due entirely to his [Mr. Mann's] researches, directed, as they were, by previous study of North American Lichens."

Manual of the Botany of the Northern United States, including the District East of the Mississippi and North of North Carolina and Tennessee. Arranged according to the Natural System. By *Asa Gray*, Fisher Professor of Natural History in Harvard University. Fifth Edition. With twenty-five plates, illustrating the Sedges, Grasses, Ferns, &c. New York: Ivison, Phinney, Blakeman, & Co. Chicago: S. C. Griggs & Co. 1867. pp. 701. [*Not* including the Mosses and Liverworts, nor the "Garden Botany."]

It must be gratifying to all lovers of Botany that the science is so widely studied as to warrant a new edition of Dr. Gray's Manual; and it is no less gratifying to students, that it makes its fifth appearance in public in such an elegant form. It is brought up to the latest and highest knowledge of the day, and its comprehensiveness, accuracy, clearness, and simplicity, its abundant synopses and analyses, its admirable plates, and its clear and well-contrasted type, make it altogether a most important acquisition to our botanical literature.

With this volume in hand, one can travel from Maine to Virginia on the coast, and westward to the Mississippi, and find therein lucid and ample descriptions of all the flowering plants he may meet in that extensive area. Everything in the way of botanical discovery in this country has focussed upon Dr. Gray's table; and the result is, that his new edition is not a mere reprint, but a rewriting of the whole work, with important and significant changes. The nomenclature of our Flora has suffered much variation, and now this last publication upon it has again made numerous alterations. Dr. Gray has, with a com-

prehensiveness which distinguishes him, swept away several of the trifling divisions which have been erected between close kindred. Some ten orders have been merged in others, and more than a score of genera have been similarly dropped out. We can now call the little *Houstonia* by its old familiar name again, and forget the flavor of *Oldenlandia* in our mouths. Those who have measured the angles of orchid anther-glands to see what degree or proximity might entitle the bearer to this or that name, will find that *Gymnadenia* and *Platanthera* are no more; but that they resurrect in *Habenaria*. Whether an anther may turn its face or back to you will not now win for it an ordinal title of *Melanthaceæ*, for it belongs to the large number of *Liliaceæ*. And no one will be longer vexed with the protean forms of oak-leaves, which have swayed him between black and scarlet, for *Quercus tinctoria* is now only a variety of *Q. coccinea*. *Alsine*, *Mœhringia* and *Honkenya* are now *Arenaria*; *Oxalidaceæ*, *Balsaminaceæ* and *Limnanthaceæ* are now all *Geraniaceæ*; *Grossulaceæ* and *Parnassiaceæ* are now *Saxifragaceæ*. As an offset to this absorption of names, Dr. Robbins has increased the twelve species of *Potamogeton* of the last edition to twenty-three in this, with varieties enough to delight a Darwinian.

Dr. Gray has omitted the Mosses, Lichens, Fungi, and Algæ, and very properly, for they are specialties in botanical science. We hope that some day the long hoped for supplementary volume may appear, in which all these orders shall be treated with equal thoroughness and accuracy, as the Mosses have been by Sullivant. Tuckerman and Curtis have all the material for their respective orders.

The plates of the Sedges are new to this volume, and have all the finish and nicety of Sprague's drawings. The young botanists of this country are favored in having for the writer of their manual one of the great masters of their science. When our hand-books are written with the same learning and breadth of treatment which are given to the most abstruse and recondite works of science, there is certainly unusual incentive and unwonted means for effort and advancement at our disposal.—C. J. S.

NATURAL HISTORY MISCELLANY.

ZOÖLOGY.

Common Objects of the Country.—From our extensive piazza, the number and variety of birds that we daily behold are to me so

marvellous, that, at the very least, I cannot forbear giving you a bit of "gossip" about them. As I have before stated, we live in the country, and are therefore supposed, by the pitying denizens of brick and stone, to be rather destitute of resources, and having no immediate neighbors, to be very dull and lonely, — but such is not possible where so many birds, insects, and creeping things abound, that the very air seems instinct with life and motion.

Sitting upon the piazza at this moment, I am not without companions, for the Mud-wasps are building upon the window ledges, the little brown Wren is in the box beneath the eaves (having first ejected the Blue-bird and its eggs), and the Carpenter-bee has accumulated quite a heap of sawdust from the railing, which is bored in more places than one by her long galleries and passages. I can also see in the gravelled walk the ridges thrown up by the Mole, of which the common and star-nosed varieties have been captured here, and can detect in the grass the perforations of another animal of the rat or mouse kind, a sight of which has thus far been denied us, as our old dog seems to think them too appetizing to exhibit before they are devoured. We only know they are plentiful, and their depredations annoying. The dogs were less particular with a muskrat which came to an untimely end through their means last season; when also a plump young woodchuck, captured by the mowers, and which they were endeavoring to place in confinement, fell a prey to their murderous propensities.

What place can be devoid of excitement where turtles are discovered feasting in the strawberry bed, and where, in the sleeve of a cast-off garment hanging in the bathing-house, we once found the nest of a field-mouse, and with breathless delight watched the frightened mother, with her large deer-like eyes and graceful motions, as she crept timidly to the spot, and one by one removed her young to a place of safety?

What revery can be lonely which is liable to be broken off by the plaintive cry of the fish-hawks, wheeling and circling about their nest, which is reared upon the summit of a blasted pine, not thirty rods from the house, and who may be descried passing overhead at any hour of the day, with some inmate of the deep depending from their talons?

We are also visited by another huge bird, a pair of which sit motionless, through the summer afternoons, upon the edge of the salt-marsh, and are known among the country people by the euphonious title of Quawks. The only ornithological description at all agreeing with them is that of the Qua-bird or *Night*-heron; and yet we certainly see them as early as three in the afternoon. In the same vicinity

we occasionally see a blue crane, and another larger bird of the heron species, describing that peculiar motion attributed by negro minstrelsy to Nelly Bly, —

> "When she walks she lifts her foot,
> And then she puts it down,"

and verily, they treat their long red legs as something to be careful of, to be deposited gingerly upon the mud, and lifted again with due deliberation. In strong contrast is the motion of the sandpiper, two or three varieties of which are always to be found gliding so quickly over the rocks, that whether they run or fly is almost a problem. In one of our drives we once captured an infant piper, and I have seen few things more comical than that minute downy ball, adorned with bill and legs, seemingly out of all proportion. Not having always lived on the sea-shore, the foregoing birds are comparatively new to me, but I do not mean to neglect the more familiar ones who haunt the trees and bushes directly about the house, — the chipping sparrow who seeks his daily meal of crumbs upon the piazza, sometimes joined by the cat-bird, — the robin, oriole, and the cuckoo, — the pewee, martin, and swallow, who all have nests within our precincts, — the noisy bobolink, and in the season of cherries, which are abundant here, a countless crowd of chatterers which it would be needless to enumerate.

I saw this spring one bird which I had never before seen, — the American Redstart, — which remained poised for a moment upon the piazza rail, so that we had a fair view of it. The ferruginous thrush, which seems quite as tame here as the robin, is almost new to me.

As the season advances, the golden-winged woodpecker and quail give themselves airs among the flower-beds on the lawn, so confident are they of not being molested; but at present we are interested in a family of owls who have frequented our trees for the last fortnight, and whose species I am unable to decide, unless it be the mottled owl. There are six in the family: the two whom we suppose to be the parents, rather object to being looked at, so that I have only had a good view of one, of which the following is a description, — back and wings of a sandy-red, with a white marking on the front of the wing similar to that on the wax-wing or cedar-bird; ears prominent, breast greyish speckled, and face ditto, with two dark lines extending from the base of the ears to the bill and enclosing the eyes. The four young ones, who generally sit side by side, and stare at us as long as we choose to stare at them, are all over of a silvery-grey, with less prominent ears. None of the company appear to be over seven inches high, and seem to haunt certain trees, where we can generally find them at any hour of the day, and they begin to be lively before sun-

set, often alighting upon the fence or the ground. We first discovered them by their peculiar hissing, like the spitting of a cat; the only other sound we have heard them emit is a faint "hoo-hoo," though while these six were in sight, we have heard the cry of the ordinary screech-owl in a grove at some distance.

Thus much for the owls, but when tired of Ornithology, we can resort to the insects, some of whom return the compliment by resorting to us; for we frequently find, in damp weather, a spider's web extending across the door (one in constant use), or from the inkstand to the ceiling

The first week in May I found lying upon the ground a large chrysalis, which was at once placed with some earth in a vacant flower-pot, and on the first of July its inhabitant appeared, and proved a stranger to us; a large yellow moth with brown markings, and looking as if peppered with minute brown dots. After a close study of Harris's Insects, we made it out to be the imperial moth, *Dryocampa imperialis*. The specimen is a female, and has been condemned for the future to contemplate surrounding objects from the head of a large pin, in company with various others of its tribe.

And when we weary of insects, there are the reptiles, toads, snakes, and turtles; the latter all sizes and kinds,—huge snapping-turtles who inhabit a small pond, the shores of which furnish a home to the crested king-fisher, as well as the fish-hawk; ugly yellow land-turtles, and brook-turtles, in small compact boxes. I have witnessed on our own door-stone the phenomenon familiar to all naturalists, of a snake swallowing a toad, though in this instance he was not allowed to finish his meal in safety; but I have failed, in spite of all my efforts, thus far, to hear the song of the toad.

Finally, when reptiles fail, there is the beach with its shells and other waifs of interest, to say nothing of crabs, eels, and porpoises; but what is a greater marvel to me than all the rest is, that such a wealth of animal life should exist unmolested within twenty miles of New York city, and in such a populous resort, that one may turn from the contemplation of Nature to that of Fashion or Art in all their splendor and perfection,—fish-hawks one moment, and flounces the next,—water-fowl and water-falls in conjunction,—but—lest you should think I mean to rival the spider who spun from the inkstand to the ceiling, I will break my thread at once.—C. PIERREPONT, *Wry Nose, N. Y.*

THE TIGER-BEETLE.—The *Cicindela* represents among insects the character of the Tiger. Its large, powerful head, with its enormous scissor-like jaws, its light body, of elegant form and gay colors, together with its ferocious habits, prove its right to the name. The

number of species is very great, and they have been carefully studied, as they have ever been the favorites of entomologists.

They are usually of some shade of green, with metallic and purplish reflections, and marked with light-colored dots and short curved lines. The Tiger-beetle abounds in sunny paths, and breeds on the sandy shores of rivers, ponds, and the ocean, over which they swiftly fly, and run in chase of their prey. The larva (Fig. 1) is hideous in aspect. It has an enormous head, with immense jaws armed with teeth on the inside, while a large swelling on the ninth segment of the curved body, which ends in a horny, movable hook, gives it a grotesque and ugly appearance. This hook aids it in climbing up its deep hole, near the entrance of which it lies in wait for weaker insects. These holes are sunk perpendicularly in the sand, and have no waste dirt about the mouth, like ant or worm holes. Their occupants may be either dug out, or on thrusting in a straw, will fiercely seize the intruding object with their hooked jaws, and, in the blindness of their rage, suffer themselves to be drawn out from their retreat.

Fig. 1.

Fig. 2.

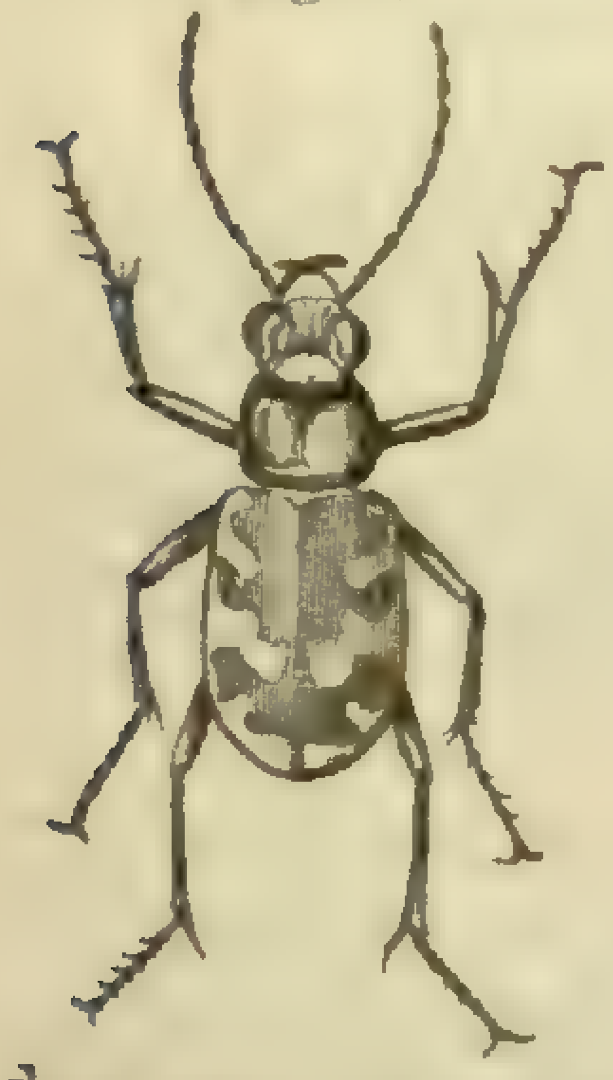


Fig. 3.

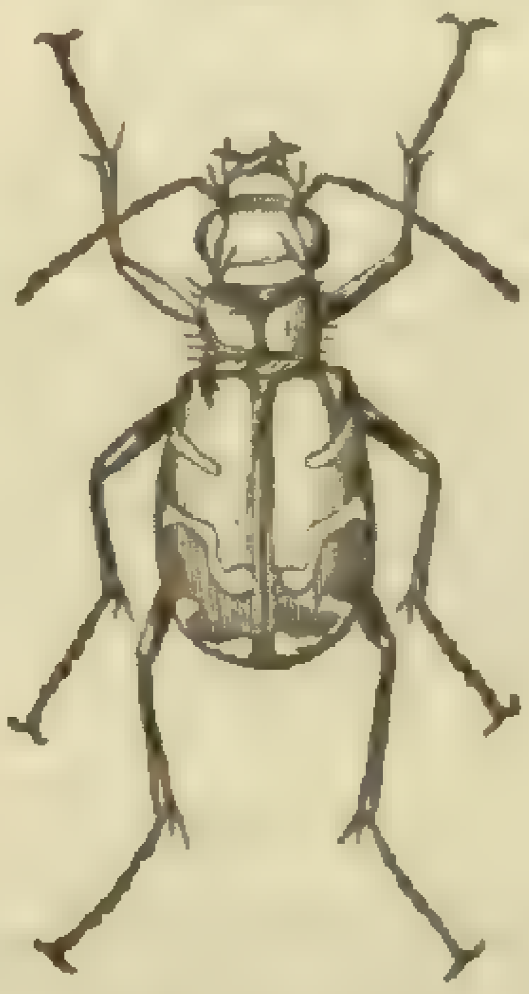


Fig. 4.

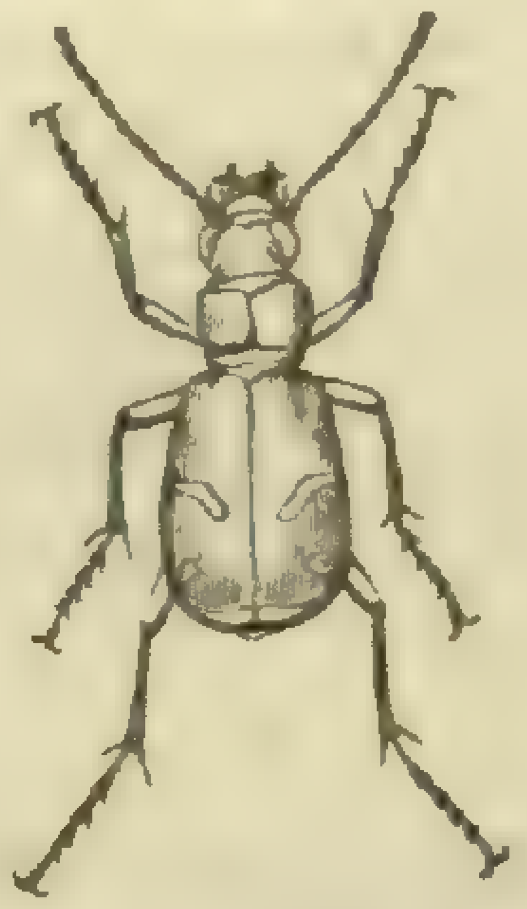
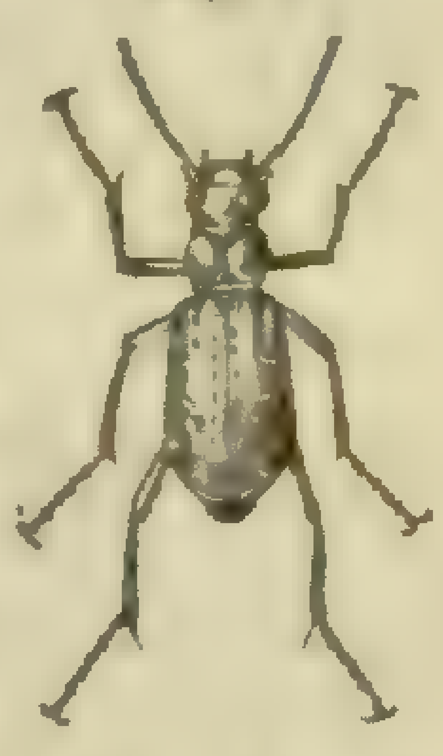


Fig. 5.

While all our native species are ground beetles, there are others in the tropics which live, in the beetle state, on trees. Among our more common forms are the *Cicindela generosa* Dejean (Fig. 2), the largest of our New England species. The most common form is the *Cicindela vulgaris* of Say (Fig. 3). One of our most beautiful species is the *C. purpurea* of Olivier (Fig. 4), found flying about sunny walks; while the hairy-necked Tiger-beetle (*C. hirticollis* Say, Fig. 5), is a smaller species than the foregoing. Our most beautiful form is the six-spotted Tiger-beetle (*C. sex-guttata* Fabricius, Fig. 6), which is of a bright green color, ornamented with six spots on the wing-covers (*elytra*). It is often found in shady places not frequented by other

Fig. 6.

Fig. 7.



species. A much smaller species is the *Cicindela punctulata* Olivier (Fig. 7), which is dark bronze, and spotted on the elytra with white dots, in place of the more usual white dots and curved lines or lunules.

GEOLOGY.

THE CRINOIDAL BANKS OF CRAWFORDSVILLE, INDIANA.—Montgomery County, of which Crawfordsville is the county seat, belongs to the Sub-carboniferous formation, being just north of the northern out-crop of the Indiana and Illinois coal-fields. A large part of the country is covered with heavy drift. Rocks in place, however, crop out abundantly along Rock (Sugar Creek on some maps) River and its tributaries. These rocks are rich in fossils characteristic of the Sub-carboniferous strata: varieties of Productus, Spirifer, Terebratula, Conularia, etc.

But the fossils which have excited the most interest, and which have rendered this locality specially noted, are the beautiful Crinoidea. Along the banks of this river are strata of limestone, made up almost entirely of the broken stems and arms of Crinoids, cemented by carbonate of lime, and occasionally containing heads finely preserved.

But the geological horizon in which the heads of Crinoids are mostly found, is a calcareous shale or sandstone, of quite limited vertical extent, not much exceeding two feet in thickness, and often but six or eight inches. In this the Crinoids are abundant, and in great perfection, the arms and basal plates being well preserved, with stems attached, and not unfrequently even the finest tentacula. They are mostly of the following types: Actinocrinus, Cyathocrinus, Agaricocrinus, Platycrinus, Forbesiocrinus, Scapiocrinus, Zeacrinus, and Pentremites. These Crinoid beds have been wrought by some of the citizens of Crawfordsville for fifteen or twenty years, prominent among whom, as most persevering and entitled to the greatest credit, both for exploring and working out specimens, is Mr. O. W. Corey. He has furnished beautiful specimens to the Smithsonian Institution, Harvard University, Yale College, Michigan University, Wabash College, and also to many private cabinets. These beds have been explored also by the students and professors of Wabash College, who have enriched her cabinet with choice specimens. The College secured, by purchase of Mr. Corey, several hundreds of perfect heads, finely wrought out, fit for the cabinet. The bank nearest to Crawfordsville is the most productive, but the same strata are found cropping out at Island Ford, on Offil's Creek, on Walnut Fork, on Black Creek, as well as at several other points on Rock River.

The most extensive excavations have been made by Mr. Charles

Dyer, of Cincinnati, an enthusiastic collector of Western fossils, some years since, and quite recently by Mr. Frank H. Bradley, of New Haven, a successful collector of specimens of Natural History. This bank is situated half a mile north of the city, in a bluff seventy-five feet above the bed of the river. The out-cropping has been so far explored, that deep and heavy excavations are requisite to reach the Crinoidal horizon.

Crinoids or Encrinites are radiates belonging to the class of Echinoderms, found chiefly fossil and extinct, there being but two living species, the Comatula and Pentacrinus Caput Medusæ. They are so named from their resemblance in form to the lily. They are among the most beautiful and wonderful fossils we have.

The Encrinite consists of a calcareous root, a hollow jointed stem, a vasiform, or cup-shaped base upon its top, from which proceed arms with subdivisions; upon some of the arms are found very fine tentacula. Besides the fixed Crinoids, there are others which were free, and some imbedded in mud.

Crinoids exist most abundantly in the oldest fossiliferous rocks, belonging to the Palæozoic and Mesozoic periods; so abundant are they in some localities in the Palæozoic localities, as to give character to the rocks, as Crinoidal or Encrinital limestone. They are found among the earliest of fossil animals. For a long time their animal origin was disputed, till established by Rosinus, in 1719.

A large proportion of the genera described belong to the Silurian formation. The Palæozoic species amount to about five hundred, and those in the rocks above to nearly one hundred. — E. O. HOVEY, *Wabash College.*

MICROSCOPY.

THE SURFACE FAUNA OF MID-OCEAN.—In the sixth volume of the "London Microscopical Journal," Major S. R. J. Owen describes several forms of towing nets for collecting microscopic forms at sea. By such nets the Polycystina, with their interesting allies the Acanthometra, and the Thalassicola, can be found: —

"I am persuaded that the genera Pulvinulina and Globigerina, of the family Colymbitæ of the Foraminifera, will be found on the surface of the ocean near home. Dr. Wallich found them in great numbers in the sediment forming the bed of the Atlantic. From seventy to ninety-eight per cent. of this deposit in the deep seas is often composed of these Rhizopods. These two genera, together with the Orbulina of Dr. Carpenter, but which I have now proved to be a sub-genus of Globigerina, have been found to be surface-forms on every part of the ocean that I have sailed over. Different classes of creatures will be found on the surface during the night to those found in the daytime: from sunset till daylight the Polycystina, Foraminifera, Acanthometra, Entomostraca, Small Pteropods, and Shelled Mollusca must be looked for; during the day the Crustaceans, Thalassicola, Creseis, etc., will repay our endeavors."

ANSWERS TO CORRESPONDENTS.

B. W. S., Ky. — Fifteen volumes of the Proceedings of the American Association for the Advancement of Science have been published: they may be obtained of the Perpetual Secretary, Prof. J. Lovering, Cambridge, Mass.

G. W. B., Maine. — Among the most important works on Entozoa, or Intestinal Worms, are Cobbold's Entozoa, 4to, London, 1867. An Essay in Aitken's Practice of Medicine. An Essay on Human Cestoids, by F. R. Sturgis, 8vo, Cambridge, 1867. Human Cestoids, by Dr. D. F. Weinland, 8vo, 75 cents; a few copies of this last work may be had at this office. The best descriptive work is Diesing's *Systema Helminthum*, 2 vols. 8vo, published in Germany. See also Owen's article Entozoa, in Todd's Cyclopædia of Anatomy and Physiology.

J. F., New York. — Many instances of snakes charming birds and other animals have been recorded, but their power to do so is still doubted by many of the best authorities.

C. G. S., Penn. — Your so-called "horse hair" is a low parasitic hair-like worm, *Gordius*, which lives in the young or larval state in the bodies of grasshoppers, etc.; but when it becomes mature, crawls out of the body of its host, and lives in the mud at the bottoms of ponds and in moist earth.

EXCHANGES.

Andrew J. Bennett, Circleville, Ohio. — Would like to exchange Western land and fresh-water shells, for New England land and fresh-water shells.

E. P. Austin, Nautical Almanac Office, Washington, D. C. — Would like to exchange U. S. Coleoptera.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE. — NATURAL HISTORY SECTION. *Burlington, Vt., August* 21-26, 1867. — "Traces of Ancient Glaciers in the White Mountains of New Hampshire, with a few Remarks upon the Geological Structure of some Portions of that Group," by George L. Vose, of Paris, Me. This was a detailed account of the observations of Mr. Vose in the Androscoggin, Peabody, and other valleys of the region, confirming the view

that these valleys have been occupied by local glaciers as well as by a general one. Mr. Vose gave an account of his observations on the geological arrangement of the rocks forming the principal range, upon which he founded hypotheses as to the early condition of that region.

"On the Origin of the so-called Lignilites or Epsomites," by Professor O. C. Marsh, of Yale College. In limestone rocks, of all geological ages, there are frequently found columnar markings, and detached columns of the rock occurring along the seam between two beds of the same. Professor Marsh gave a notice of the different publications on the subject, showing what a puzzle they have long been to geologists. He exhibited a series of fine specimens, showing that they were due to pressure. Professor Marsh has been the first to show that the form of many perfect columns is due to the presence of a fossil shell or some foreign substance.

"On the Geographical Distribution of the Sediments and the Fossils in the Hamilton, Portage, and Chemung Groups of New York," by Professor James Hall. The object of the paper was to show that identity of fossil species must not be expected in rocks of the same geological age over wide geographical areas.

"Upon some remarkable Fossil Fishes obtained by Rev. H. Herzer from the Devonian Rocks at Delaware, Ohio," by Professor J. S. Newberry. Professor Newberry exhibited some splendid specimens of these fish remains, which Mr. Herzer obtained from concretions in the rock. The remains belonged to a genus of ganoid fishes, now made known for the first time. The fish must have been one of the monsters of the waters of those times, and very formidable. The head could not have been less than three feet long by two feet broad. On account of the great size, he had named it Dinicthys.

"The Fossil Insects of North America," by S. H. Scudder. This paper was a review of the entire subject, noticing eighty species of fossil insects, known in the strata of this continent. The oldest preserved remains of insects now known are from the Devonian rocks of New Brunswick, and furnish evidence that insects were introduced about the time that land-plants first appeared.

"Depression of the Sea during the Glacial Period." By Col. Charles Whittlesey. The existence of an ice epoch, during which the northern hemisphere above about latitude 40° was enveloped in ice *nevé* and snow, being now generally admitted, I propose to notice the effects which would necessarily follow in depressing the surface of the ocean.

It is universally admitted that there have been in North America

changes of level, either of the land or the sea, or both, during the ice period, particularly towards its close.

I wish to consider principally the changes of sea-level resulting from the accumulation of continental ice. Such accumulations can only occur by depositions of moisture from the clouds, derived from the ocean by evaporation. The water-line, or surface of the sea, is constant, only because there is an equilibrium between evaporation and the water returned through the rivers. If depositions, in the form of rain, dew, and snow, remain perpetually congealed, they are not returned to the common reservoir, and to that extent its surface must settle away. If the limits of perpetual snow and ice should now be enlarged, these effects should follow. A decrease of temperature of *one degree* annually would lower the snow line about three hundred feet per annum, and increase the area of snow *nevè* and ice, while evaporation would measurably cease; but over which deposition would continue.

The area supposed to have been covered by the ice mantle in North America, Northern Asia, and Europe, is equal to about *one-fifth* of the northern hemisphere. The ice-field must also have encroached upon the bays, fiords, sounds, lakes, and minor sea spaces adjacent, which with the enlargement of the South Pole Continent, I assume to be as much more, or equal to *one-fifth* of the surface of the globe. The evaporating surface of the ocean became restricted, as the congealed surface of the land and the sea enlarged, and the ocean mass became diminished.

In reference to dry land, the present ocean is determined to be as three to one; the earth presenting a surface three-fourths water and one-fourth land. Geographers estimate the water surface at 111,000,000 of square miles, the land at 37,000,000. If both the extent and the thickness of the ice covering could be determined, its mass would be easily fixed, and also the increase or diminution it would cause in the waters of the sea.

Dr. Hayes penetrated seventy miles from the sea at Port Foulke, Greenland, over the continental ice, which attained an elevation of 5,000 feet. The ice-grooving in New England reaches a height varying from 4,300 to 5,300 feet above the present level of the sea. Ice etchings extend from beneath the waters of Lake Superior to the tops of the highest mountains, 1,000 to 1,200 feet above its surface. The ice coating may have been 1,500 to 2,000 feet thick over much of the central part of British America. Its bulk is about one-tenth greater than water, and, dissolved on the same space, would fill a height of nine-tenths, or ninety feet in a hundred.

If it attained an average thickness of 2,000 feet in a solid state, it

would, in a liquid form, rise to 1,800 feet on the same area. If one-fifth of the earth was enveloped in congealed water, and four-fifths of its surface was free, the transfer of the liquid portion from the sea to the land, where it should remain, would depress the sea one-fifth of the vertical distance above assumed, for the water produced by the melting ice.

Dynamical results may have followed the accumulation of continental ice. The continent of Greenland is considered to be settling at a perceptible rate, — of necessity a sinking of one part of the earth's surface involves a rise in another, and generally an adjacent part, — accordingly the island of Newfoundland is reported to be rising. Professor Hall and other geologists claim that accumulations of detritus may reach a point where, by weight alone, depression must follow. If this theory is tenable, a load of ice would produce like results.

I present this idea for the consideration of geologists, when they study the phenomena of the fresh-water drift and terraces of the Great Lakes, which now stand on a level with the marine drift beds of Lake Champlain and the St. Lawrence. In the interior, over vast spaces extending to the Rocky Mountains, north and west of the lakes, there are no known elevations exceeding 2,000 feet above tide. A sinking seems to have taken place over this region, while the seacoast as far as the east end of Lake Ontario was rising, the axis or line of rest being near the middle of this lake, and its bearing nearly across it.

California Academy of Natural Sciences. *San Francisco, July 1, 1867.* — The eggs, caterpillar, female and cocoon, of the California silk-worm (*Saturnia Californica*, or *Euryalus* of Boisduval), were presented by Dr. Lanszweert, who remarked that the number of eggs of this silk-worm is from two hundred to two hundred and fifty. The female lays, on an average, from seventy to eighty per day. Three thousand eggs weigh an ounce. The caterpillar, direct from the egg, is more lively than that of the Chinese silk-worm, and hardly keeps in its place. The silk produced by this worm is stronger than that of the Chinese, and is indigenous to California. Living on the *Ceanothus*, it is well worth the attention of our silk-growers, as perhaps in feeding it on the mulberry a finer quality of silk would be obtained. The eggs were obtained from a female caught in the garden of the Philadelphia Brewery, Second street, in this city, on the 10th of June. The eggs were hatched on the 30th of the same month. The caterpillar requires generally from two to two and a half months before making its cocoon.

Mr. Stearns exhibited specimens of *Haliotis* from Monterey, which he had received from Dr. Canfield, of that place. The peculiarity of the specimens consisted in their being *hybrids*—a cross between the two species known to conchologists as *H. Cracherodii* and *H. rufescens*. In this connection Mr. S. made some general remarks upon the *Haliotidæ*. Dr. Cooper followed Mr. Stearns, and remarked upon the geographical distribution of this genus of mollusca.

A paper was read by Dr. W. P. Gibbons, of Alameda, in which he resumed the subject of the extinct forest of redwood on the Coast Range, near San Antonio. He directed attention to the fact that some of those stumps indicated a method of growth different from ordinary forest trees. Their immense size was due, in some cases, to the fact that three or four trees, growing in proximity, would ultimately impinge on each other, and if supplied with sufficient nourishment, they would grow together and form one immense trunk. This theory was verified by the statements of Dr. Kellogg and Mr. Bolander, who mentioned the fact that near Searsville several redwood trunks had grown together, and for forty feet formed a solid tree. There is no dependence in estimating the age of such trees in any other way than by carefully counting the number of concentric growths from a centre. The oldest of these redwoods is about 1,500 years of age. The *gigantea* of Calaveras is about the same age. These redwoods are evidently the second generation of the race; hence we may infer that 3,000 years, at least, have passed by since the present growth first commenced on the Coast Range. But long before this must vegetation have covered portions of these hills, as the *Sequoia* reposes in a bed of alluvium twenty or thirty feet in depth. He also referred to the bulbous expansion of these trees near the base. These are composed of large expanding roots, growing together, and forming a complete network. The height of this indicates the degree of denudation which the soil has undergone during the lifetime of the tree. This is about five feet in 1,500 years. Some of these trunks have from 10,000 to 14,000 buds, partially developed, around their base, each bud having the power, under favorable conditions, of being developed and containing a perfect tree. The mass of wood contained in a tree twenty-five feet in diameter is equal to 40,000 cubic feet, weighing over 2,500,000 pounds.

BOOKS RECEIVED.

A Manual of the Botany of the Northern United States. By Prof. Asa Gray. 8vo, 1867.

Epitome of Elocution. By B. W. Atwell. Providence, 1867. 12mo.

The American Bee Journal, Vol. I. Vol. III, No. 5, November, 1867.

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AN ACCOUNT OF SOME KJŒKKENMŒDDINGS, OR SHELL-HEAPS, IN MAINE AND MASSACHUSETTS.

BY JEFFRIES WYMAN, M. D.

Crouch's Cove, Casco Bay, Maine.

Any one who would take the trouble on going to a strange city, to examine the rubbish in its suburbs and streets, and carefully collect and compare the fragments of pottery, pieces of cloth, of paper, cordage, the bones of different animals used as food, worked pieces of stone, wood, bone, or metal, might gain some insight into the

Entered according to Act of Congress, in the year 1867, by the Essex Institute, in the Clerk's Office of the District Court of the District of Massachusetts.

modes of life of the inhabitants, and form a fair conception of the progress they had made in the arts of civilization. Even after a city has become a ruin, and centuries have passed by, such examinations have been attended with fruitful results. A savage tribe, dwelling for a long period on one and the same place, would inevitably leave vestiges of the manner in which they lived, though these would, of course, be fewer in kinds just in proportion as the people were nearer to a primeval condition.

The former dwelling-places of the Aborigines of the United States are nowhere more plainly indicated than along the seaboard, where some of the tribes passed a portion, at least, of each year, in hunting and fishing; some no doubt living there permanently, while others, it appears, made visits only at stated periods.* The clam, the quahog, the scallop, and the oyster, entered largely into their food, and the castaway shells of these, piled up in many years, have not only become monuments of their sea-shore life, but have largely aided in the preservation of the bones of the animals on which they fed, and also of some of the more perishable implements used in their rude arts.

The shell-heaps on the Atlantic coast long since attracted notice. Dr. C. T. Jackson, and afterwards Professor Chadbourne, visited the remarkable one at Damariscotta, in Maine; Sir Charles Lyell has particularly described another on St. Simon's Island, in Georgia,† and quite recently Mr. Charles Rau, of New York, has given a full and instructive account of the examination of another at Keyport, New Jersey.‡ We have ourselves

* "Quand les sauvages vont a la mer pour y passer quelques mois a la chasse des canards, des outards, et des autres oiseaux qui s'y trouve en quantite," etc. Lettres du P. Sebastian Rasles a Narantsook ce 25 Oct., 1722. Lettres Edifiantes, Paris, 1838.

† Second Visit to the United States. New York, 1849. Vol. I. p. 252.

‡ Smithsonian Report, 1864, p. 370.

examined two on the sea-coast of East Florida, and still others in considerable numbers on the banks of the upper St. John's, in the same State. These last-mentioned heaps consist wholly of the shells of fresh-water species. We may have something to say of them hereafter, but at present shall only speak of such as were visited on the coast of Maine and Massachusetts during the summer and autumn of the year just past. Of the localities where these are situated, and of the structure of the heaps, we shall speak as briefly as possible; but shall enter somewhat fully into details, in connection with the implements and the remains of animals found in them. It is to be understood, however, that the heaps here described are only a very small portion of those to be seen along the coast of these two States, and which offer an ample reward to any who will take the trouble to examine them.

Frenchman's Bay. Mount Desert is the largest of the islands on the indented coast of Maine, and forms the western shore of Frenchman's Bay. Many shell-heaps are scattered over this and the adjoining islands and the main land. Williamson,* without particularly designating them, mentions the existence of several from one to two acres in extent, and states that "a heavy growth of trees was found upon them by the first settlers." We have examined two. The first of these is in Gouldsboro', on the main land, and near the water's edge on the eastern shore of the bay. It is said to cover an acre of land, but being under cultivation was examined only near its border, where a pit was sunk showing a deposit of clam-shells about two feet in thickness. Among these were found the bones of several animals, including those of the

* History of the State of Maine. Hallowell, 1832. Vol. I. p. 80.

deer, elk, and beaver, but no implements of any kind. Stone implements have, however, been found by those who have cultivated the soil of this neighborhood.

A more complete examination was made of a second deposit on one of two small islands, neither of which are named, about a mile west of the place just mentioned.* This heap is seen on a bank, at a height of about six feet above the high-water mark, varies in thickness from a few inches to about three feet, and extends along the shore about two hundred and fifty feet, and from thirty to forty feet inland. A section through the heap at its thickest part showed that it belonged to two different periods, indicated by two distinct layers of shells. The lowest, a foot in thickness, consisted of the shells of the clam, whelk, and mussel, all much decomposed, and mixed with earth. Above this was a layer of dark vegetable mould, mixed with earth and gravel, and from six to eight inches in thickness. Above this was a second layer of shells, of the same species as those just mentioned, but in a much better state of preservation, and with less intermixture of earth; this deposit was in turn covered by another layer of earth and mould, and these now sustain a growth of forest trees, but none of them of large size. From the state of things just described, it would seem that the place had been reoccupied, after having been once abandoned long enough for a vegetable mould to be formed, and a layer of earth from some neighboring source to be deposited over it. Charcoal was found in considerable quantity, scattered among the shells, and the remains of an old fireplace were uncovered. The bones of animals, and the various kinds of implements (Pl. 14, figs. 3, 4,

*The two heaps were examined in company with Dr. Calvin Ellis, Messrs. John L. Hayes, William A. Hayes, and R. E. Fitz, to whom the writer is indebted for valuable specimens found by them.

5; Pl. 15, figs. 10, 11) obtained during the excavations, will be described in another page.

Crouch's Cove. This is situated on Goose Island, in Casco Bay, about fifteen miles north-east of Portland. The whole island is at present covered with a growth of spruce trees (*Abies nigra*), excepting a narrow strip on the seaward side, and on this, at the southerly end of the island, are several shell-heaps of different sizes. The longest of these is about one hundred and fifty feet in length, forty in width, and varying in thickness from a few inches to nearly three feet. Considerable portions have been washed away, and the contents scattered along the shore. The shells are mostly deposited evenly, but here and there are raised into small knolls, and all are covered with turf. This deposit has been carefully examined by Mr. C. B. Fuller, of Portland, by whom large collections have been made, and a portion of which were unfortunately destroyed by the great fire of 1866. Mr. Edward S. Morse has more recently made a partial examination, and obtained many valuable specimens, which will be mentioned farther on.

Our examinations* were begun on the bank and carried inland, until about 375 square feet of surface, and more than 700 cubic feet of material had been moved. Mr. Morse has given the following account of the shells found in this, and some of the smaller deposits near by. He enumerates the following species: "Common Clam (*Mya arenaria*), Quahog (*Venus mercenaria*), Large Scallop (*Pecten tenuicostatus*), Large Mussel (*Mytilus modiolus*), Cockle (*Purpura lapillus*), Beach Snail (*Natica heros*), Whelk (*Buccinum undatum*), Periwinkle (*Littorina lito-*

*The excavations were made by Rev. J. A. Swan, and Messrs. E. S. Morse, F. W. Putnam, Horace Mann, Edwin Bicknell, and the writer. The sketch of the locality was made by Mr. Joseph P. Thompson.

ralis); and also the following, for which there are no common names: *Nassa obsoleta*, *Natica triseriata*, and *Macoma fusca*. The following land snails were also met with: *Helix albolabris*, *Sayii*, *alternata*, *lineata*, *striatella*, *indentata*, *multidentata*, *Zua lubricoides*, and *Succinea Totteniana*."

"The heaps were almost entirely composed of the shells of the common clam, which appeared longer and rougher in texture than that now dug near by. In some of the heaps the shells of the quahog were abundant, and marked for their size and solidity. This species, though no longer found in the same cove with the heaps, may be had in the neighborhood of Goose Island, but localities in which it lives are quite rare north of Cape Cod. The common mussel, whelk, cockle, and scallop, were probably used as food, while the other species were doubtless carried there by accident. The presence of so many species of land snails would seem to indicate that the island was once covered with hard-wood trees, among which these animals alone flourish. The occurrence of the little snail, *Zua lubricoides*, is inconsistent with the view that it is an introduced species."

The shells were deposited in two different layers, very much as on the island in Frenchman's Bay already described. The older was separated from the more recent deposit by a thin stratum of earth, extending through the largest portion of the heaps. Pieces of charcoal were scattered everywhere among the shells, but in some places the larger quantity and the blackened earth showed where fires had been made. The number of the fragments of the bones of edible animals was quite large, belonging to no less than fifteen species. Besides these, many bones of other species, bone implements (Pl. 14, figs. 1, 2; Pl. 15, figs.

6, 7, 8, 9, 12, 13), and pieces of bone from which portions had been sawed off were found; no implements of stone were exhumed, though Mr. Swan found a small pestle, and Mr. Morse a chisel lying on the surface near the shore.

A third deposit was examined at *Eagle Hill*, in Ipswich, Massachusetts, situated on the borders of a creek, by which easy access is had to the sea-shore. The whole neighboring region consists of a series of low hills of gravel, some of them covered with boulders, but entirely destitute of forest trees. A few basswood trees (*Tilia Americana*) have been known to exist there within a few years, but otherwise those hills do not appear to have been wooded within the memory or traditions of the present inhabitants. Several shell-heaps are reported to exist in the neighborhood, but the only one examined was on the easterly side of the hill mentioned above. This consists of several disconnected deposits of shells, which are in part spread out into a uniform layer, but in a few instances form small knolls from eight to ten feet in diameter. Near the water's edge the shells are exposed by the washing away of the bank, but elsewhere are covered with mould and turf, and, in some places, even on the knolls, with a layer of gravel. In the more even portions, this last may have been washed down from the slopes above, but such could not have been the case with the knolls, for the tendency would have been to denudation rather than to covering up. The shells, forming these deposits, are almost exclusively those of the common clam, which are still found here in great quantities, and yield a considerable revenue to those engaged in digging them. Large piles of recently dug shells may be seen along the neighboring shore, and noticeably contrast with those from the Indian shell-heaps, in being thinner and

less rough in their texture. Shells of the oyster and the Mactra were found, but few in number. Somewhat extensive excavations* yielded bones of the deer, beaver, dog, birds, among these the bones of the turkey, and of fish; but only a single implement of stone, which was spherical in shape, with a groove around the middle of it. This was found by Mr. Putnam just beneath the surface. Some of the bones showed distinct marks of cutting instruments, and a few pieces of wrought bone were found, three of which are represented in Pl. 15, figs. 15, 16, 17. Two distinct fireplaces, indicated by hard-wood charcoal, ashes, and blackened earth were found, resting on the earth and beneath the shells.

In the town of *Salisbury*, Massachusetts, a series of heaps thirteen in all, quite near together, consisted exclusively of the shell of the clam. They are about a mile from the left bank of the Merrimack River, near its mouth, and surrounded by a series of sand-downs, some wooded, others naked; these last constantly changing from the action of the wind. They vary in size from about twenty to more than one hundred feet in diameter, but the shells form a layer of only a few inches, and are largely mixed with sand. After a careful search, in company with Mr. Alfred Osgood, of Newburyport, we failed to find in most of them any of the works of man, except only a few flakes or "chips" of flint; but on two, both near together, large quantities of chips were scattered over the surface, and more than five pounds were picked up. Besides these, several arrow-heads and fragments of pots, made of burned clay mixed with coarse sand, were found. No bones of animals, which might have served for food, were noticed, though carefully looked for. In previous years,

*Made by Messrs. E. S. Morse, F. W. Putnam, C. Cooke, and the writer.

large numbers of stone implements of various kinds have been carried away; but as the place is in the neighborhood of a large town, and is frequently visited by those in search of such relics, they are now nearly exhausted.

Cotuit Port is in the town of Barnstable, on the south side of Cape Cod, and on the northern shore of a narrow bay. It is quite near to the sea, but protected from it by a narrow spit of land, which forms a natural breakwater across the bay at its mouth. Within the distance of a few miles, a large number of shell-heaps are met with, and have been estimated to cover hundreds of acres, sometimes having a thickness of between one and two feet, and at others of only a few inches. Oysters were formerly found in the bay in much larger quantities than at present, and doubtless formed one of the chief attractions which drew the Indians to this place. Our examinations were confined chiefly to one of the larger deposits, about a mile to the eastward of the village, situated on a sloping surface with a pleasant southerly exposure. Excavations by four persons during a whole day were made near the shore, and at various points inland, and brought to light the shells of the oyster, clam, scallop, and quahog, in large numbers, but quite unequally distributed; the clam being plentiful in some places, the quahog in others, and the scallop in others, while the oyster abounded everywhere.

Two species of *Pyrula*, viz.: *P. carica* and *P. canaliculata* were found, the first in considerable numbers. Neither of these species was found in any of the other heaps. Dr. Gould states that they are not known to exist north of Cape Cod. The largest specimen of the *P. carica* was about seven inches in length, a portion of the spire having been broken off, and this, according to Dr.

Gould, is their maximum size on the Coast of Massachusetts. It is, however, in remarkable contrast with a shell of the same species from one of the shell-heaps in Florida, which measured nearly fourteen inches in length.

Of the remains of vertebrates, the bones of the deer were the most abundant; but those of the seal, the fox, the mink, of birds, including those of a duck and the wild turkey, of turtle and of fish were found. During a former examination of this locality by Mr. George G. Lowell and Dr. Algernon Coolidge, a canine of a bear and a part of the skull of a cat was obtained. No stone implements, but a few worked pieces of bone were dug up, and also some fragments from which portions had been sawed off. The tine of a deer's antler, from which the tip had been sawed off, is represented on Pl. 15, fig. 14. About two-thirds of the metatarsal bone of the great toe from a human foot was found, in company with the bones of the animals already mentioned, and is the only portion of the skeleton of man which we have discovered while examining the heaps here described. The writer would express his obligations to Mr. George G. Lowell for the opportunity of examining the locality at Cotuit Port, and for the gift of valuable specimens.

Age. Shell-heaps have become intimately associated with the question of the age of the human race, a question which has passed out of the domain of the written, into that of geological history. It can only be satisfactorily answered by following the method of the geologist, when he attempts to determine the period when a given animal existed in former geological times, viz., by a careful comparison of the remains of such animal with those of existing species, and by an accurate study of the geological and other physical conditions under which they are found.

In Denmark, such methods applied to the *Kjækkenmæddings*, or refuse-heaps, have yielded results of great importance to archæology, and have shown that some of these heaps at least, as in Seeland along the Isefjord, date back to a period when their geological surroundings were somewhat different from what they now are, when the shores were less raised above the sea, and the oysters, of the shells of which the heaps are made up, had not yet retreated to where the fresher waters of the Baltic, at the present time, mingle with the ocean in the Kategatt.

The shell-heaps we have here described yield nothing which indicates as high an antiquity as those of the old world. The materials of them present some variety in the degree of decomposition which has resulted from time and exposure, the lower layers being much more disintegrated and friable, the shells in fact falling to pieces, while those of the upper ones generally preserve their original firmness. That there was a difference in time in which these layers were deposited, is further indicated by the fact, that, in two of the heaps, a stratum of earth is interposed between the earlier and later deposits, as if the locality had been abandoned as a camping place, and then after a prolonged absence of the natives had been reoccupied. Each heap, too, is covered with a deposit of earth and vegetable mould, of variable thickness, and in some cases, as at Frenchman's Bay, supporting a growth of forest trees, though these were nowhere of such size as to indicate that they had lived a century. Mr. Morse has called attention to the abundance of *Helices*, or land snails, which were exhumed at Crouch's Cove, and to the fact that these require a hard-wood growth for subsistence, while at present the island, on which this cove is situated, is covered with spruces. It is also noticeable

that there has been in all the localities, except at Salisbury, a disintegration of the shores, the sea undermining and destroying the deposits. There can be no doubt that these were once much more extensive than now, and that the water has worked its way into their places. Lastly, these deposits contain the remains of animals, as of the elk, not known at present to exist to the eastward of the Alleghany Mountains; of the wild turkey, now virtually extinct in New England; and of the great auk, which, unless it still live on some of the small islands to the north of Newfoundland, has receded almost, if not quite, to the arctic regions.

All these circumstances are certainly signs of the lapse of time. Nevertheless, in the absence of any positive data as to how long a period is necessary for the accumulation of vegetable mould, or for the washing of earth from the slopes above on to the heaps below, or for the rate of decomposition of shells in a given time, or of the rate of the denudations of the shores; and in view, too, of the fact that the animals represented in the heaps, but now no longer met with in the regions of them, have all disappeared within the historic period of this continent, it will be readily admitted that proof of great age or "high antiquity" is not found in any or all the circumstances which have been mentioned above.

On the other hand, it may be safely said that there is nothing in the condition of these heaps which is inconsistent with the hypothesis that they were begun many centuries ago. The examinations at Crouch's Cove, Eagle Hill, and Cotuit Port were sufficiently extended to enable us to obtain a fair representation of the objects they contain; but in no case was there found, nor have we been able to learn, that there had been previously found a

single article which could be regarded as having been made by, or derived from the white man, nor did we obtain any evidence that these particular heaps had been materially added to since the European has occupied these shores. Had intercourse with Europeans been once fairly established, it were a reasonable presumption that we should have found at least a glass bead, a fragment of earthenware, or an instrument of some sort indicative of the fact, especially when we bear in mind that it would be in just such places, where the savages collected around their fires and seething-pots to cook and eat, that such objects might be expected to be broken or lost. Finally, if the statements of Williamson on the authority of Johnson be correct, viz., that "a heavy growth of trees was found on them" (the deposits of clam-shells near Mount Desert) "by the first settlers," we have something like satisfactory evidence that their age could not have been less than between three or four centuries.

Remains of Animals. Human remains have not been found in the shell-heaps of Denmark, except in the case of casual burials, as of a shipwrecked sailor, or of burials from some other unusual occurrence, and these are of a modern date. The same absence of human remains marks the shell-heaps we are describing, with a single exception. At Cotuit Port an unequivocal metatarsal bone from the great toe of the human foot was discovered. No other bones were found with it, except those of animals. It was so deeply buried, and its appearance was such, that no doubt exists that it was of the same age as the heap itself; we have therefore assigned it a place in the following table, which gives a list of the species of animals uncovered and identified by their bones, or shells, in the different heaps, and shows their relative distribution through them.

	Kinds of Animals found in the Shell-heaps.	Mount Desert.	Crouch's Cove.	Eagle Hill.	Cotuit Port.
1	Man,				*
2	Elk (*Cervus Canadensis*),	*			
3	Moose (*Alce Americanus*),	*	*		
4	Caribou (*Rangifer Caribou*),		*		?
5	Deer (*Cervus Virginianus*),	*	*	*	*
6	Bear (*Ursus Americanus*),		*		*
7	Wolf (*Canis occidentalis*),	*			
8	Dog (*Canis*),	*		*	*
9	Fox (*Vulpes fulvus*),				*
10	Cat (*Felis*),				*
11	Otter (*Lutra Canadensis*),		*		
12	Mink (*Putorius vison*),		*		*
13	Sable (*Mustella Americana*),		*		
14	Skunk (*Mephitis mephitica*),				*
15	Seal (*Phoca vitulina*),	*	*		*
16	Beaver (*Castor Canadensis*),	*	*	*	
17	Woodchuck (*Arctomys monax*),	*			
18	Great Auk (*Alca impennis*),	*	*		
19	Razor-bill (*Alca torda*),	*			
20	Ducks (three species),	*	*		
21	Wild Turkey (*Meleagris gallopavo*),			*	*
22	Heron (*Ardea herodias*),		*		
23	Tortoise (two species),				*
24	Shark,				*
25	Cod (*Morrhua Americana*),	*	*	*	
26	Goose-fish (*Lophius Americanus*),		*		
27	Whelk (*Buccinum undatum*),	*	*		
28	*Pyrula carica*,				*
29	*Pyrula canaliculata*,				*
30	Oyster (*Ostrea edulis*),	*	*	*	*
31	Clam (*Mya arenaria*),	*	*	*	*
32	Quahog (*Venus mercenaria*),		*	*	*
33	Mussel (*Mytilus edulis*),	*	*	*	*
34	Scallop (*Pecten tenuicostatus* and *P. Islandicus*),		*		*
35	Hen-clam (*Mactra*),		*		

Besides the species of shells mentioned above, and which may be regarded as having been used for food, there were also found species from the following genera, probably accidentally introduced, viz.: *Tritonium*, *Littorina*, *Nassa Zua* and *Purpura;* seven species of *Helix;* three species of *Natica*.

A glance at the above table shows what a great variety of animals was brought to these places by the Indians.

Some were hunted as articles of food, others for their skin, and still others for both. Precisely where the line is to be drawn between those which are and are not edible, or what animal an Indian would absolutely refuse to eat, it is impossible to say. Although the kinds of meat used were in the main palatable, the natives certainly did not hesitate to make use of some which do not commend themselves to the taste of civilized people. Josselyn, who, of all the earlier writers, has given the most complete account of the animals found on the coast of New England, states that "the Indians, when weary with travelling, will take them (the rattlesnakes) up with their bare hands, laying hold with one hand behind their head, with the other taking hold of their tail, and with their teeth tear off the skin of their backs, and feed upon them alive, which, they say, refresheth them."*

The bones of the deer and birds outnumber those of all the other kinds. The condition in which they are found bears a striking resemblance to that of the bones from the shell-heaps of Scotland, the Orkneys, and Denmark. Nearly all the fragments from the *deer* were those of the long bones, which in the living animal are either covered by the largest amount of flesh, or contain the most marrow. Not one of them was whole, all having been broken up for the double purpose of extracting the marrow, a custom almost world wide among savages, and often practised by hunters, and of accommodating them to the size of the vessel in which they were cooked. Even the phalanges of the toes were treated in the same way.

The bones of the *bear*, though much less numerous, were similarly broken up, and in two instances had been carbonized by contact with the fire. Among the speci-

*New England's Rarities Discovered. London, 1672. p. 39.

mens collected by Mr. Morse in his first visit to Crouch's Cove, was the last molar from the lower jaw. The crown was somewhat worn, but the ridges were not all effaced; it was of small size, measuring 0.55 inch in length, and 0.46 in breadth. The average size of eight specimens of the same molar in the black bear was, length 0.60 inch, breadth 0.47, while that of two specimens from the polar bear was, length 0.54 inch, breadth 0.45. The tooth from the shell-heaps, therefore, as regards size, more closely resembles the last-mentioned species, as it does also in the shape of the crown,—but it would be unsafe, from a single specimen of the molar in question, to attempt to identify them. The former existence of the polar bear, on the coast of Maine, is rendered quite probable by the fact that the tusk of a walrus has actually been found at Gardiner.* Sir Charles Lyell obtained a portion of the cranium of another at Gay Head, Martha's Vineyard.† It was found by a fisherman who supposed that it had fallen from a cretaceous bed in the cliff above. Perhaps it may have been of a more recent date, and a contemporary of the Great Auk.

The presence of the bones of the *dog* might be accounted for on the score of its being a domesticated animal, but the fact that they were not only found mingled with those of the edible kinds, but like them were broken up, suggests the probability of their having been used as food. We have not seen it mentioned, however, by any of the earlier writers, that such was the case along the coast, though it appears to have been otherwise with regard to some of the interior tribes as the Hurons. With them, game being scarce, "venison was a luxury found only at

*Observations on the Glacial Phenomena of Labrador and Maine. By A. S. Packard, jr. Mem. Bost. Soc. Nat. Hist. Vol. I. p. 246.

†Travels in North America. New York, 1845. Vol. I. p. 205.

feasts, and dog flesh was in high esteem."* We have not found any marks of cutting instruments, as was the case with the bones found by Steenstrup in the shell-heaps of Denmark, and from which circumstance he inferred that dogs were eaten. In fact, they have served as food in so many parts of the world, that the use of their flesh anywhere ought not to be considered an improbability.

A whole left half of the lower jaw of a *wolf* was found at Mount Desert, measuring 7.5 inches in length, making a strong contrast in size, with a similar half from a dog found at Crouch's Cove. This was more curved, and had a length of a little less than five inches.

The bones of *birds*, like those of the deer, were almost without exception broken, but in quite a different manner. In the latter it was the shaft that was shattered, the ends often remaining uninjured; while in the birds the shaft was whole, and the ends not only broken off, but nowhere to be found. It is not to be supposed that they were so broken off for the extraction of the marrow, since those containing only air were treated in the same way. Steenstrup having observed the same fact in the remains from the Danish shell-heaps, suspected that they were mutilated by dogs, and accordingly by way of experiment, having kept some of these animals on short diet, gave them various bird bones to eat. He found, as he had anticipated, that they ate the ends, rejecting the shaft. He explains their choice by the greater sponginess, and easier digestibility of the former as compared with the dense middle portion of the latter. No doubt an additional inducement was found in the remains of flesh, tendon, and ligament, which would usually remain adherent to the ends, after the portions ordinarily eaten

*Parkman. Jesuits in America. Boston, 1867. p. 30.

had been removed. On looking over the specimens of our collections, marks of teeth of animals were frequently noticed, some of them of such size as might be made by dogs, but others by a much smaller animal, as a cat or mink.

Of the remains of birds, by far the most interesting are those of the Great Auk (*Alca impennis*), which formerly had a much wider geographical distribution than now, for having followed the glaciers in their retreat, at present it is confined to the arctic and subarctic regions. In Europe it formerly existed, as appears from the evidence of the shell-heaps, on the shores of Scotland, the Orkneys, and it has recently died out in Iceland. In the United States we have the authority of Steenstrup and Prof. Baird for its former existence as far south as Cape Cod. There can be but little doubt that the last survivors lingered till after the arrival of the Europeans. The description of the "Wobble," by Josslyn, as far as it goes, applies to the Great Auk, "an ill-shaped bird, having no long feathers in their pinions which is the reason they cannot fly ; not much unlike a penguin."*

There are various traditions along the sea-coast of its having been seen at a much later date. Audubon, however, in his voyage to Labrador saw none in the Straits of Belle Isle, but was told that they still bred on an island north of Newfoundland.

The remains of the Great Auk in the shell-heaps of Maine, were in sufficient numbers to show that it must have been common, since seven specimens of the humerus alone were found, besides fragments of the cranium, jaws, and sternum. The specimens of humerus differed remarkably in condition from the same bone of other birds

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*New England's Rarities Discovered, p. 11.

found with them, in not being mutilated; for of the seven specimens, four were whole, and the fifth had lost but one end, while of the humeri of the other kinds, scarce one was whole enough to enable one to identify the species. They seem not to have been attractive to the dogs. They are characterized by their much flattened shape, thick walls, narrow cavity, and the absence of an opening for the entrance of air. Well-preserved specimens of the coracoid bone were also found entire.

The catalogue we have given of the animals found in the shell-heaps shows that the elements of variety in food certainly existed, especially if we add to these the maize, beans, squashes, and various kinds of roots Indians are known to have used. From the testimony of eye-witnesses, soon after the settlement of the country, it appears that while sometimes the Indian contented himself with maize roasted, or with this and beans made into a pottage, he often, when the necessary materials were at hand, made what might well be called a hodge-podge. Gookin gives a full account of the manner in which this was concocted. In a word, it consisted of a mixture of fish and flesh of all sorts. "Shad, eels, alewives," "venison, beaver, bear's flesh, moose, otters, raccoons, or any kind that they take in hunting," are cut into pieces, bones and all, and stewed together. "Also they mix with said pottage séveral sorts of roots, as Jerusalem artichokes, and ground nuts, and other roots, and pompions, and squashes, and also several sorts of nuts or masts, as oak-acorns, chesnuts, walnuts. These, husked and dried and powdered, they thicken their pottage therewith."*

Father Rasles† expresses his disgust at their style of

* Historical Collection of the Indians of New England, in Collections of Massachusetts History Society. Boston, 1792. p. 150.
† Lettres Edifiantes et Curieuse. Vol. I. p. 670.

cooking and eating, and Wood evidently had a poor stomach for "their unoat-mealed broth, made thick with fishes, fowles, and beasts, boyled all together, some remaining raw, the rest converted by overmuch seething to a loathed mash, not half so good as Irish boniclapper."* When visiting the English, if offered food, Wood informs us they ate but little, "but at home they will eat till their bellies stand forth ready to split with fullness."*

Works of Art. Pottery is poorly represented, only small fragments having been found. Like those from other parts of the United States, the pots were made of clay, with or without the admixture of pounded shells, and were imperfectly burned so that the walls are both friable and porous. The ornamentation, when it exists, is of the rudest kind (Pl. 14, fig. 18), consisting of indentations or tracings with a single point, or, as in some cases, with a series of points on one and the same instrument. Both at Crouch's Cove and Cotuit Port, specimens were found in which the lines in the surface had been formed by impressing an evenly twisted cord into the soft clay (Pl. 14, fig. 19), the cord being laid on in various positions. This kind of ornamentation has a special interest, since there is evidence of its having been made use of in widely distant places. We have found similar specimens on the banks of the St. John's in Florida; there are others from Illinois, presented to the Peabody Museum by J. P. Pearson, Esq., of Newburyport, and others have been noticed in the ancient barrows of England.† This kind of ornament has given rise to the belief that the pots were moulded in nets, which were removed after the vessel was finished. All the specimens we have seen are wanting in

*New England's Discovered Rarities. London, 1635. p. 59.
† Prehistoric Times, by John Lubbock, 1865. p. 113.

any indication of a regular mesh, or of the existence of knots where the cords crossed, which, if they existed, as they must have in a net, could not have failed to be represented.

Implements. It is somewhat remarkable that with the exception of the shell-heaps at Salisbury, all of those here described yielded so few articles made of stone. At Mount Desert only two arrow-heads were found, at Crouch's Cove Mr. Swann found a pestle, and Mr. Morse a rude chisel, both picked up on the shore, but probably washed out from among the shells. At Eagle Hill, Mr. Putnam found a spherical stone with a groove around it, but at Cotuit Port not a single piece of worked stone was discovered. In regions adjoining the different shell deposits, especially at Cotuit Port, an abundance of stone implements have been found, and those who have preceded us have occasionally obtained some from the heaps. In the Danish heaps, they seem to have been quite common, and Mr. Rau found them so at Keyport.

Implements of *bone*, on the other hand, are quite abundant, as were also fragments of bone showing the marks of the instruments by which pieces had been detached, and of such there was a considerable variety. Some of the bones were cut across by making a groove around the circumference, as one would cut a notch in a stick, and breaking the rest; and others, as the metatarsal bones of the elk and deer, were split lengthwise, by making a groove on each side nearly to the marrow cavity, and completing the division by fracture. The roughly striated surface of the groove, and its undulating course indicate a piece of stone, and not a saw, as the instrument with which the work was done. We have found by experiment that this mode of working bone does not prove so great a labor

as it might at first sight seem to be, and with care have succeeded in splitting in two, lengthwise, in the course of an hour, a piece of human ulna seven inches long, by means of a flint "chip" held in the hand. This, of course, involves a large expenditure of time, but it must be remembered that an Indian's time was not valued. The work is rendered very much easier by keeping both the instrument and bone wet. It has been objected to the opinion, that certain implements from the European heaps were used as saws, that having wedge-shaped edges they would soon become "choked" or "jammed." Practically this does not happen, for we have uniformly found that the roughness of the sides of the flint is sufficient to widen the groove as fast as the edge deepens it.

Implements of bone made by the Indians dwelling in New England have rarely been mentioned, and are seldom seen in collections, but if one may judge from the number of specimens we have obtained, must have been in quite common use. The inhabitants of the North-west Coast, and the Esquimaux, are largely dependent upon this material, and Messrs. Squier and Davis found a few bone instruments in the mounds of Ohio. The accompanying figures, drawn by Mr. Morse, represent the forms of the more important ones discovered in the different heaps, which form the subject of this paper. Except the first, which is reduced one-half, linear measurement, all are represented of the natural size. We are unable to assign any uses for the larger part of them, and of the others can only offer a conjecture.

EXPLANATIONS OF PLATES 14 AND 15.

Fig. 1. This instrument is ten inches long, two inches and a half broad at the top, and one at the point. It is made of one of the branches of the antler of the moose or elk. The breadth of the upper

Fig. 1.

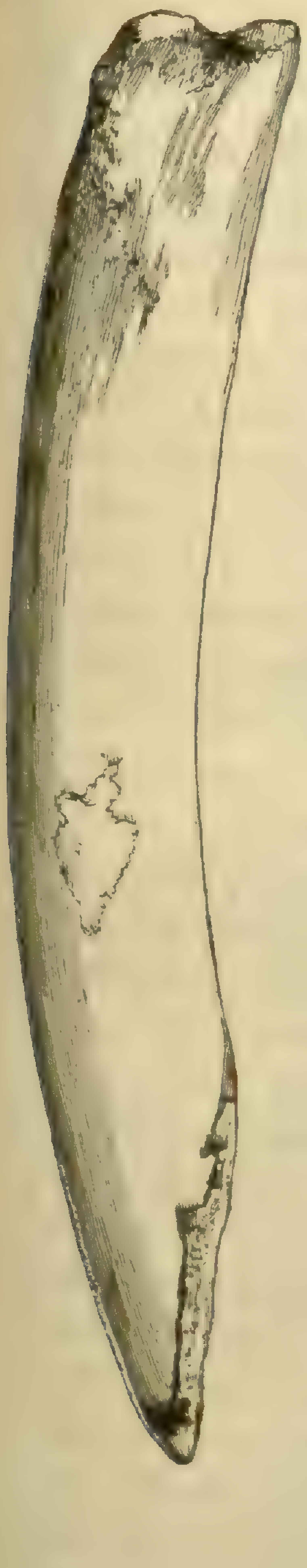


Fig. 4.

Fig. 5.

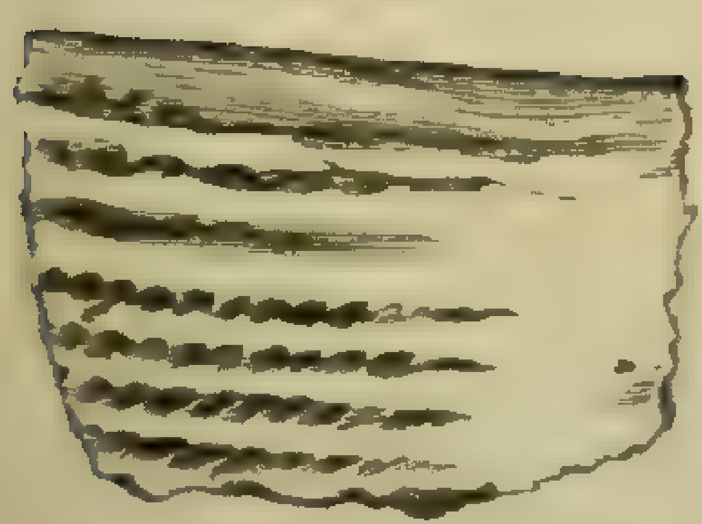
Fig. 3.

Fig. 2.

Fig. 2 *a*.

Fig. 18.

Fig. 19.



WYMAN ON THE SHELL-HEAPS OF NEW ENGLAND.

Fig. 9.

Fig. 10.

Fig. 8.

Fig. 11.

Fig. 14.

Fig. 7.

Fig. 16.

Fig. 15.

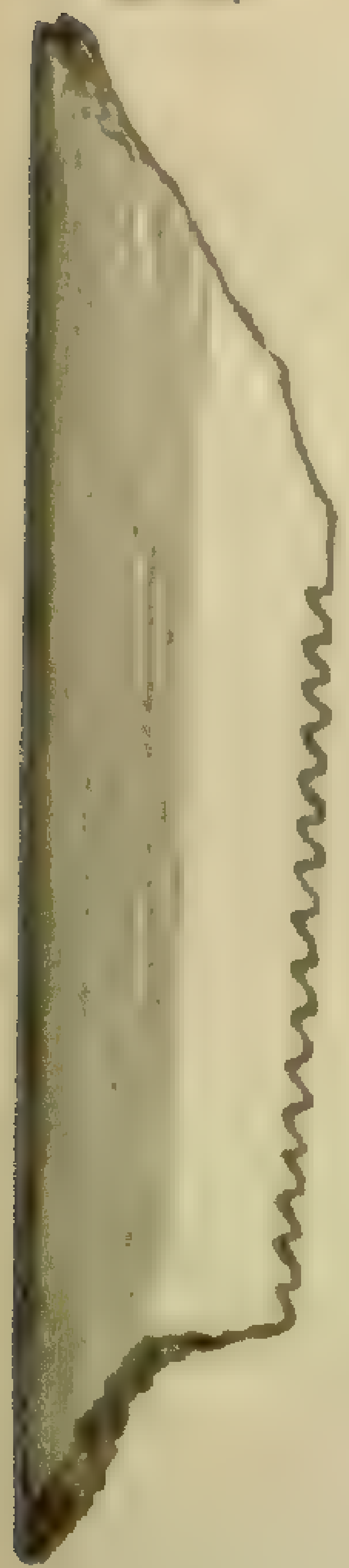


Fig. 13.

Fig. 6.

Fig. 12.

Fig. 17. 17*a*.

WYMAN ON THE SHELL-HEAPS OF NEW ENGLAND.

portion is not seen in the figure, as the piece is represented as seen edgewise. It is obliquely truncated at the lower end, so as to give it a chisel-shaped edge, and shows the effect of having been hacked by some dull tool. Attached to a handle it might be used to dig with, or might serve for the purpose of a head-breaker, or "casse-téte," as described by Father Rasles.* From Frenchman's Bay.

Fig. 2. A flat-pointed instrument, 3¾ inches long, and 1¼ wide. This is made of the dense exterior portion of an antler, and at the lower end has a thin sharp edge as in Fig. 2 *a*. From Crouch's Cove.

Fig. 3. A piece of one of the branches of the antler of a deer, from which the tip has been cut off. The sides near the pointed end have been worked down so as to present four faces, two of the angles uniting them being quite acute. The detached piece having a deep notch would be provided with two points or barbs, and would be adapted to serve as the point of an arrow. Such points were used by the aborigines, and we are informed by Winslow, that when the Pilgrims were making their first explorations on the shore at Cape Cod, previously to landing at Plymouth, some of the arrows shot at them had the kind of point just described.† From Cotuit Port.

Fig. 4. An artificially pointed fragment. From Crouch's Cove.

Fig. 5. An artificially pointed fragment of bone, suitable for the purpose of an awl. From Crouch's Cove.

Fig. 6. A fragment of a bone of a bird, obliquely truncated and artificially sharpened. From Crouch's Cove.

Fig. 7. One of the lower incisors of a beaver, ground to a thin, sharp edge, which last is formed by the enamel on the inner, or flat side of the tooth. From Crouch's Cove.

Fig. 8. A well wrought and polished spindle-shaped instrument, the lower end of which is flattened, and has a sharp edge; the upper portion is rounded with the end broken off, but appears to have been worked to a sharp point. From Frenchman's Bay.

Fig. 9. A slender piece of bone, smoothly wrought and pointed. From Frenchman's Bay.

Figs. 10 and 12, from Frenchman's Bay, and 11 and 13, from Crouch's Cove, are all made of flattened pieces, each being cut from the walls of one of the long bones, and showing the cancellated structure on one of the sides.

Fig. 15. From Eagle Hill; the serrated edge is quite sharp, but from this the bone rapidly increases to one-third of an inch in thickness, so as to render it wholly unsuitable to be used as a saw.

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* Lettres Edifiantes et Curieuse. Paris, 1838. Vol. I. p. 670.
† Young's Chronicles of the Pilgrims. Boston, 1841. p. 158.

Figs. 16 and 17 are flat, scraped very thin, as seen in 17*a*; one of them is made from the bone of a bird. From Eagle Hill.

The specimens represented by the figures just enumerated, together with other wrought pieces more or less mutilated, and collections of the bones and shells from each of the heaps, are preserved in the Peabody Museum of Archæology and Ethnology at Cambridge, and in the Ethnological Department of the Essex Institute in Salem. Of these specimens, those represented in Figs. 6, 7, 11, 13 and 14, were from the Rev. J. A. Swan; Figs. 1, 9, 12 from Mr. William A. Hayes; Figs. 2 and 4 from Mr. Horace Mann; Figs. 10 and 17 from Mr. F. W. Putnam; Fig. 15 from Mr. E. S. Morse, and Figs. 3, 5, 8, 10, from the writer.

KJOEKKENMOEDDING

THE CHICKADEE.

BY AUGUSTUS FOWLER.

THE Chickadee (*Parus atricapillus*) is a common resident, familiar alike in the woods and the dwellings of man. He fears not the storms of winter nor the heats of summer. Cautious yet bold, cunning though seemingly simple, he averts all suspicion of the whereabouts of his nesting-place, and, when discovered, scolds the intruder. Ever on the alert, the hawk cannot make him his prey, nor the smooth gliding snake surprise him in his nest. In times of incubation when danger approaches, the male,

before unseen, sallies forth and instantly appears before the intruder, hopping from branch to branch, keeping but a short distance from him, and remaining silent until he fears their retreat may be discovered, then he sounds the alarm. At the noise the female peeps out of her abode, and quickly dodges back to wait the issue. If their nesting-place is not seen, or the male has artfully drawn the person away, the pleasing notes, *Phe-be*, *Phe-be* are heard; but if the nest is disturbed, and the female routed, they are clamorous in reiterating the notes, *Pe-dee-dee-dee*. If their nest is destroyed, they linger about a day or two, then go in quest of another suitable place to build again, such as a rotten stump or decayed upright limb of a tree or post, which is easily perforated, and dig a hole in it to the depth of six to nine inches, with a diameter usually of two and a quarter inches.

They are often many days in preparing their tenement. Their labors are commenced in the morning of each day, both male and female working, and they work until about the middle of the forenoon, when they stop, and are seldom seen about the premises until the next morning. It seems as though the task before them would depress their spirits and discourage them in their undertaking, but energy and perseverance will accomplish much: bit by bit of rotten wood is taken out of the hole and carried by each bird ten or fifteen feet from the tree and dropped on the ground. There is no delay in their work except what arises from the difficulty of detaching the particles of wood from the sides or bottom of the cavity; for each bird, after dropping its light load, flies back to near the entrance and waits for the other to appear, when it enters the branch instantly. When the hollow is finished the bottom is concave, as usual in birds' nests.

There is usually in the vicinity of the nest a hollow tree, or cavity made on purpose for the male to roost in during the time of breeding; such retreats are also occupied by them in severe stormy weather in winter, in which they sometimes remain three or four days in succession. They make their nests of different materials; sometimes it is entirely of cow's hair, at others entirely of wool; usually it is composed of various materials, such as those named, together with fine grass, the fine dried roots of the willow, etc., and lined with some soft material. Its inside diameter is one and three-fourths inches; its depth one and one-fourth inches. The eggs, which are commonly eight in number, measure in length nine-sixteenths of an inch, and in breadth eight-sixteenths of an inch. They are marked with reddish-brown specks over the entire egg, more thickly at the larger end; sometimes, however, the spots are thicker on the smaller end of some of the eggs of the same brood. They raise two broods in a season. The Chickadee, when compelled from necessity to take up his abode in a cavity not made by himself, selects one with an entrance not much larger than his body, so that he is not so liable to become the prey of the Mottled-owl, as are the Golden-winged Woodpeckers, and Blue-birds. There are no species of birds that suffer so much from the depredations of the owl as the Golden-winged Woodpeckers. The deadliest foe to the Chickadee is the Great American Shrike, or Butcher-bird. Seated upon some prominent object the Shrike watches the movement of the little troop as they are busily engaged seeking their food in a variety of positions, unconscious of the sure death that awaits one of their number. While listening to the squeaking notes of the Brown Creeper which usually attends them, or

the shrill clarion voice of the Downy Woodpecker, you hear a noise like a falling stone through the branches of the tree; it is the shrike: he has struck his victim, and if he does not devour it upon the spot, it is hung on the crotch of a limb to serve as a meal at some future time.

DESMIDS AND DIATOMS.

No. II.

THEIR GROWTH AND GEOLOGICAL IMPORTANCE.

BY PROF. L. W. BAILEY.

[Concluded from page 517.]

In descending from the study of the higher to that of the lower forms of life, nothing is more remarkable than the manifold and often varied means by which that life is multiplied and perpetuated. In all four departments of the Animal Kingdom this is found to be the case, the higher groups in each producing for the most part a limited number of offspring, which, however, they nurse with proportionate care, while, as we pass to those occupying a lower grade, Nature seems to guard against the extinction of a species by vastly augmenting the reproductive power of the individual. So strikingly is this the case, that fishes, worms, the moss-like mollusca and the polyps, the lower groups under their several types, have been well styled the Embryonic or Reproductive Classes. Nor is this observation true only within the limits of a single department. It is equally the case when one of these classes is compared with another, the difference, however, now appearing not so much in an inequality in the number of actual offspring, as in the introduction of new modes of

multiplication, other than the development from eggs. It is true that the numbers of possible young contained in the roe of certain fishes far exceeds anything to be found in the case of either of the classes just alluded to, but of these comparatively few reach maturity; while, slightly among the worms, still more among the flower-like mollusca, and in a most remarkable degree among the coral-polyps, a new mode of reproduction is introduced, by which not mere immature undeveloped individuals only are brought forth, but individuals fully formed, perfect in all their organs, ready to assist at once in the labors of the community of which they form a part.

Hence it is, perhaps, that the lower forms of life have been and are of incomparably more importance than the higher, in modifying the earth's physical features, and in contributing material for its growth. The coral-polyp is a pigmy indeed beside the Mastodon, but while a fragmentary skeleton of the latter is here and there unearthed, the solid framework of the latter has, to a considerable extent, become also the framework of the globe, a portion of the masonry by which, tier upon tier, our continent has risen through successive ages.

In passing from the Animal to the Vegetable Kingdom, the fact to which we have made allusion is equally apparent. Reproduction by *seed*, though the normal, is by no means the only nor indeed the usual method of propagation. Were this the case, and were every form of vegetation but a single individual, how infinitely reduced would be that individual's chances of successfully resisting the thousand accidents to which it is subjected, how infinitely less varied and less beautiful would be the development of vegetable life. But every botanist knows, and every gardener practically proves, that a shrub or tree

is not a single indivisible being, but a *community* of individuals, each of them a potential plant, living, it is true, in intimate connection with others of its kind, but equally capable of living alone, when, with proper care, its connection with these latter is severed. Every plant, as it buds in spring, is but reproducing hundreds or perhaps thousands of new individuals, similar in every respect to that which originally sprung directly from the seed. Unlike what is seen in the Animal Kingdom, the higher as well as the lower orders share equally in this peculiar mode of growth; with this difference, however, that while among the higher groups the newly formed parts retain their connections, and become a portion of a compound structure, in the humbler groups they often separate as soon as formed, and acquire a distinct and independent existence.

Let us now observe some of the results of this process, as illustrated in the minute forms of vegetation to which this paper is more especially devoted.

In the last number of the NATURALIST it was shown, that, among the Desmids and Diatoms, though "conjugation" and the formation of seed-like bodies or spores is a normal mode of reproduction, yet here, as among higher plants, multiplication by this method is comparatively unimportant, by far the greater number of individuals arising from the self-division or fission of a single cell. So true is this, indeed, that the former mode, although probably true of all, has as yet been observed in but very few, and those the least remarkable species, while the process of budding or self-division is universal. Indeed, it is scarcely possible to examine a recent gathering of Diatoms, in which individuals will not be found illustrating all the different stages of development, from those in

which the "connecting membrane" has merely become slightly enlarged, to those in which it may be seen to contain two new individuals; these latter ready, by the disruption of the membrane, to acquire a separate existence, or, as is more commonly the case, to still maintain some slight connection with the parent cell, thus forming new members in a compound community.

The rapidity of this budding process is something astounding, and goes far to explain the geological importance of these organisms. Ehrenberg, the great microscopic observer, in alluding to this subject, observes that "the silicious infusoria (Diatoms) form, in stagnant waters during hot weather, a porous layer of the thickness of the hand. Although more than 100,000,000 weigh hardly a grain, one may, in the course of half an hour, collect a pound's weight of them; hence it will no longer seem impossible that they may build up rocks;" and Professor Smith, the author of a standard work on these organisms, has calculated, as the progeny of a single diatomaceous cell, the amazing number of one thousand millions in a single month. These facts are certainly calculated to awaken our astonishment, yet wonderful as they are as illustrations of the reproductive power, they are but a repetition of what actually occurs throughout the whole vegetable kingdom. Take for example the century plant of our conservatories. An excellent authority tells us that, shooting forth its flower-stalk at the rate of a foot in twenty-four hours, it actually produces no less than twenty thousand millions of cells in a single *day;* and many other plants, in a greater or less degree, illustrate the same fact. In both cases the new cells are microscopic, but while in the higher forms they remain aggregated to produce a close and compact structure, of a more

or less limited duration, among the Diatoms the new cells become new individuals; and though, as *living* forms, their duration is brief, yet incorporating as they do into their tissues the almost indestructible element, silica, to a greater extent than in any other group of organisms, they become as it were *petrified*, even while still alive, and at death leave behind relics, minute indeed, but imperishable, the most perfect of fossils, in which every groove and marking of their former selves is accurately and beautifully preserved.

We have, then, only to reflect for a moment upon the almost universal distribution of the Diatomaceæ, to understand how, by rapid growth and the formation of indestructible remains, they may readily become of great importance in a physical and geological point of view. They are found alike in fresh, salt, and brackish water; in moist earth and in tidal muds; in hot springs and in river ice, from the poles to the equator, coloring vast tracts of the surface of the sea, as well as composing the great bulk of the ocean's bed. Even in the lava and cinders of volcanoes their presence has been recognized, and they form a large portion of the dust-showers and "blood-rains" formerly so dreaded, and which cover at times with powder the sails of ships at sea. Mr. Roper, an English microscopist, tells us, that, excluding coarse sand, one-fourth of the finer part of the residuum of the mud of the Thames is composed of the silicious remains of the Diatomaceæ, and expresses his belief that their silicious shells "have a perceptible influence in the formation of shoals and mud-banks." Dr. Hooker, again, in speaking of the results obtained by the Antarctic Expedition, observes that they abound in the newly-formed ice of the Polar Seas, producing by their death a submarine deposit of vast

dimensions, occupying probably an area of 400 miles long by 120 wide, resting in part upon a glacier 400 miles in length, and in part upon the submarine flanks of Mount Erebus, an active volcano 12,000 feet in height! Finally, Ehrenberg considers that at Pillau, in Germany, "there are annually deposited from the water from 7,200 to 14,-000 cubic metres of fine microscopic organisms, which, in the course of a century, would give a deposit of from 720,000 to 1,400,000 cubic metres of Infusory-rock or Tripoli-stone."

So much for the rapidity of growth and the physical importance of the Diatoms in our own era; let us now glance for a moment at earlier periods, and see whether these minute organisms were then too at work, producing results at all comparable to those which we witness at the present day.

To begin with the more recent geological epochs. Every tyro in microscopic inquiry has, among his other curiosities, obtained at least one slide with the label "Fossil Infusoria." These are Diatomaceæ, and the deposits from which they are derived may be found in all parts of our country, cropping out on the borders of ponds, or underlying layers of peat. It is, however, often a matter of doubt, especially in the former case, where the forms of the deposit and those still living in the water are apparently identical, how far these may really be entitled to the designation of "fossils." That they are so in many cases, and almost always when underlying beds of peat, is shown by the entire absence in these latter of certain species (especially *Nitschia* and *Synedra*), while these species are *growing* in the waters of the same locality in the greatest profusion. The period of the introduction of these species, then, must constitute

one epoch in the geological history of the Diatoms, and more attentive study will yet reveal the occurrence of similar special epochs in the case of other species, even though we may not be able to directly synchronize these epochs with those determined from other data.* But leaving the region of uncertainty, there are numerous deposits, the great antiquity of which is placed beyond a doubt. Among these we may first enumerate a deposit in which were found imbedded, in 1843, the bones of a Mastodon, in Orange county, N. Y., and which, from its peculiar connection with these bones, was undoubtedly of contemporaneous origin. Being unaffected by severity of climate, it is probable that the Diatoms continued to exist through the whole Post-tertiary Period, affording, by the entire absence of marine species, another confirmation of the much-disputed Glacier theory of Professor Agassiz. Again receding, the next deposits of which the age may be considered as definitely fixed, are those of Virginia and Maryland, the most celebrated of all diatomaceous earths, from the extreme variety and beauty of their forms and the extent of the beds containing them. These beds, where they underlie the city of Richmond, are not less than twenty feet in thickness, and consist entirely of marine remains; while deposits, similar in character, and probably contemporaneous in origin, are found at many localities as far as Piscataway, in the State of Maryland. They are referred by their discoverer, Professor W. B. Rogers, to the Miocene Tertiary. One cubic inch of the earth has been calculated to contain not less than several millions of individual shells. Many similar deposits have been observed both in America and

*For an interesting article on this subject, see a paper entitled "Some new and intermediate Forms of Diatomaceæ," by Dr. F. W. Lewis, in the Proceedings of the Philadelphia Academy of Natural Sciences, December, 1863.

Europe, but little has as yet been done in determining their precise age, or in accounting for the conditions necessary for the local accumulation of such vast quantities of material. Among the most remarkable in this respect are those of our western coast. I have now before me a block of pure diatomaceous earth, a foot and a half long by half a foot in depth, of chalk-like whiteness, sent by Mr. W. P. Blake, from Monterey (the entire weight of which is only about six pounds), and other similar beds are found at many points in Mexico, California, and Oregon. One of these, discovered by Colonel Frémont on the Columbia River, surpasses all other known deposits, being not less than 500 feet in thickness, and covered by at least 100 feet of compact basalt and other volcanic products!

It is probable that the Mexican and California beds, like those of Richmond, are of Tertiary age, though some of them may prove to be Cretaceous. That those of Monterey and San Francisco are far more ancient than the present physical features of California is proved by their being purely marine deposits, and by their differing wholly in character and species from other deposits, also of considerable thickness, from the eastern side of the Sierras, which I have lately had an opportunity of examining. These latter are fluviatile or lacustrine, and contain many species identical with those of the ordinary subpeat deposits of the Eastern States.

In passing from the Tertiary to earlier formations, the evidence of the existence of the microscopic Algæ becomes less evident, and for a long time none were believed to exist of more ancient date than those above alluded to. Certain peculiar organisms termed Xanthidia were, however, observed as of frequent occurrence in

the flint-nodules of the chalk formation, and within a still more recent period similar forms have been observed in the analogous hornstones of the Devonian and Silurian ages, associated in this latter case with unequivocal Diatomaceous shells. As regards these Xanthidia, which have usually been regarded as remains of Desmids, it is certainly singular that, while all recent Desmids are purely fresh water, these should occur in marine deposits: and secondly, that, destitute as they are for the most part of the silicious shell of the Diatoms, they should occur in a fossil state at all. Yet the resemblance is certainly a striking one, and their occurrence with the kindred Diatomaceæ throws some degree of plausibility upon this belief. However this may be, the existence of one group at least of these organisms being established for these early periods, we can scarcely doubt that their numbers were as great then as in the seas of our own day, and that they have been present through all the great geological ages, even though metamorphism and other agencies have for the most part obliterated all traces of their beautiful but fragile shells. It is highly probable that accompanying the lower forms of animal life, these humble types of vegetation were among the first introduced upon the globe, performing then, as their representatives now do in the arctic seas and at great depths, where the higher forms of vegetation are wanting, the part of purifying the waters, as well as of contributing food for the sustenance of the different forms of animal life with which they were associated.

Thus we see that the lower no less than the higher forms of life have their appointed place, each fulfilling its own part, and each worthy of the admiration and the study of the observing mind.

THE HOME OF THE BEES.

BY A. S. PACKARD, JR., M. D.

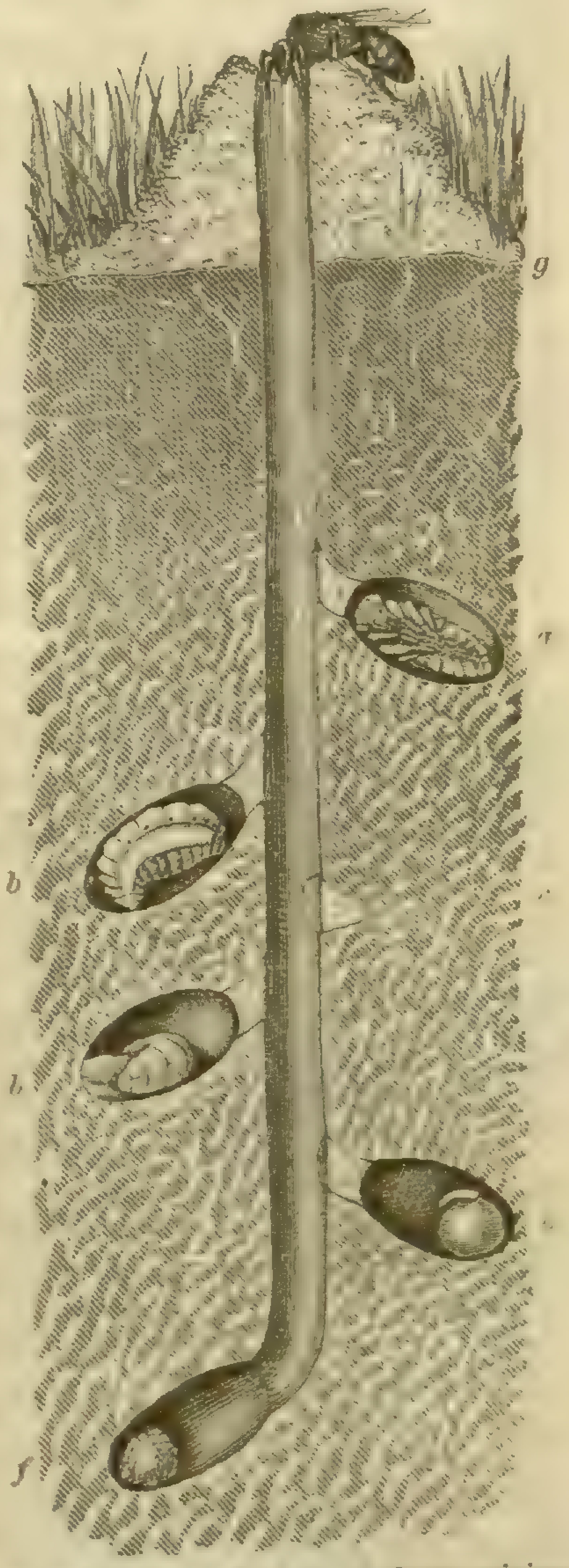
(Concluded from page 378.)

WHILE the Andrena and Halictus bees, whose habits we now describe, are closely allied in form to the Hive-bee, socially they are the "mud-sills" of bee society, ranking among the lowest forms of the family of bees, or *Apidæ*. Their burrowing habits ally them with the ants, from whose nests their own burrows can scarcely be distinguished. Their economy does not seem to demand the exercise of so much of a true reasoning power and pliable instinct as characterizes those bees, such as the Honey and Humble-bee, which possess a high architectural skill. Moreover they are not social; they have no part in rearing and caring for their young, a fact that lends so much interest to the history of the Hive and Humble-bee. In this respect they are far below the wasps, or *Vespidæ*, a family belonging next below in the system of Nature.

A glance at Mr. Emerton's admirable drawing (Fig. 1) of a burrow of *Andrena vicina* Smith, reveals the economy of one of our most common forms. Quite early in spring, when the sun and vernal breezes have dried up the soil, and the fields exchange their rusty hues for the rich green verdure of May, our Andrena, tired of its idle life among the blossoms of the willow, the wild cherry, and garden flowers, suddenly becomes remarkably industrious, and wields its spade-like jaws and busy feet with a strange and unwonted energy. Choosing some sunny, warm, grassy bank (these nests were observed in the "great pasture" of Salem), not always with a southern exposure however, the female sinks her deep well through

the sod from six inches to a foot into the sandy soil beneath. She goes to work literally tooth and nail. Reasoning from observations made on several species of wasps, and also from studying the structure of her jaws and legs, it is evident that she digs in and loosens the soil with her powerful jaws, and then throws out the dirt with her legs. She uses her forelegs like hands, to pass the load of dirt to her hind legs, and then runs backward out of her hole to dump it down behind her. Mr. Emerton tells me that he never saw a bee in the act of digging but once, and then she left off after a few strokes. He also says, "they are harmless and inoffensive. On several occasions I have laid on the grass near their holes for hours, but not one attempted to sting me; and when taken between the fingers, they make but feeble resistance."

Fig. 1.



Nest (natural size) of *Andrena vicina*, showing the main burrow, and the cells leading from it: the oldest cell containing the pupa (*a*) is situated nearest the surface, while those containing the larva (*b*) lie between the pupa and the cell (*e*) containing the pollen mass and egg resting upon it. The most recent cell (*f*) is the deepest down, and contains a freshly deposited pollen mass. At *c* is the beginning of a cell; *g*, level of the ground.

To enter somewhat into detail, we gather from the observations of Mr. Emerton (who has carefully watched the habits of these bees through several seasons) the following account of the economy of *An-*

drena vicina. On the 4th of May the bees were seen digging their holes, most of which were already two inches deep, and one six inches. The mounds of earth were so small as to be hardly noticed. At this time an Oil-beetle (*Meloë*) was seen prowling about the holes. The presence of this dire foe of Andrena at this time, it will be seen in a succeeding paper on the enemies of the bees, is quite significant. By the fifteenth of May hundreds of Andrena holes were found in various parts of the pasture, and at one place, in a previous season, there were about two hundred found placed within a small area. One cell was dug up, but it contained no pollen. Four days later, several Andrenas were noticed resting from their toil at the opening of their burrows. On the twenty-eighth of May, in unearthing six holes, eight cells were found to contain pollen, and in two of them a small larva. The pellets of pollen are about the size of a pea. They are hard and round at first, before the young has hatched, but as the larva grows the mass becomes softer and more pasty, so that the larva buries its head in the mass, and greedily sucks it in. When is the pollen gathered by the bee and kneeded into the pellet-like mass? On June 4th, a cell was opened in which was a bee busily engaged preparing the pollen, which was loosely and irregularly piled up, while there was a larva in an adjoining cell nearly half an inch long. It would seem, then, that the bee comes in from the fields laden with her stores of pollen, which she elaborates into bee-bread within her cell.

When the bee returns to her cell she does not directly fly towards the entrance, since, as was noticed in a particular instance, she flew about for a long time in all directions without any apparent aim, until she finally settled near the hole, and walked into her subterranean

retreat. On a rainy day, May 24th, our friend visited the colony, but found no bees flying about the holes. The little hillocks had been beaten down by the pitiless rain-drops, and all traces of their industry effaced. On digging down, several bees were found, indicating that on rainy days they seek the shelter of their holes, and do not take refuge under leaves of the plants they frequent.

On the 29th of June six full-grown larvæ were exhumed, and one about half grown. On the 20th of July the colony seemed well organized, as, on laying open a burrow at the depth of six inches, he began to find cells. The upper ones, to the number of a dozen, were deserted and filled with earth and grass roots, and had evidently been built and used during the previous year. Below these were eight cells placed around the main vertical gallery, reaching down to the depth of thirteen inches, and all containing nearly full-grown larvæ of the bees, or else those of some parasitic bee (*Nomada*) which had devoured the food prepared for the young Andrena.

About the first of August the larva transforms to a pupa or chrysalis; as at this time two pupæ were found in cells a foot beneath the surface. As shown in the cut, those cells situated lowest down seem to be the last to have been made, while the eggs laid in the highest are the first to hatch, and the larvæ disclosed from them the first to change to pupæ. Four days later the pupæ of *Nomada*, or Cuckoo-bees, were found in the cells. No Andrenas were seen flying about at this time.

On the 24th of August, to be still very circumstantial in our narrative, though at the risk of being tedious, three burrows were unearthed, and in them three fully formed bees were found, nearly ready to leave their cells, and in addition several pupæ. In some other cells

there were three of the parasitic Nomada also nearly ready to come out, which seemed to be identical with some bees noticed playing very innocently about the holes early in the summer.

On the last day of August, very few of the holes were open. A number of Oil-beetles (*Meloë*) were strolling suspiciously about in the neighborhood, and some little black Ichneumon flies were seen running about among the holes.

During midsummer the holes were found closed night and day by clods of earth.

The burrow is sunken perpendicularly, with short passages leading to the cells, which are slightly inclined downwards and outwards from the main gallery. The walls of the gallery are rough, but the cells are lined with a mucous-like secretion, which, on hardening, looks like the glazing of earthen-ware. This glazing is quite hard, and breaks up into angular pieces. It is evidently the work of the bee herself, and is not secreted and laid on by the larva. The diameter of the interior of the cell is about one-quarter of an inch, contracting a little at the mouth. When the cell is taken out, the dirt adheres for a line in thickness, so that it is of the size and form of an acorn.

The larva of Andrena (Fig. 2) is soft and fleshy, like that of the Honey-bee. Its body is flattened, bulging out prominently at the sides, and tapering more rapidly than usual towards each end of the body. Seen sideways, the thoracic rings are quite prominent, giving a serrated outline to the body. The skin is very thin, so that along the back the heart or dorsal vessel may be distinctly seen, pulsating about sixty times a minute.

Our cut (Fig. 1) also represents the pupa, or chrys-

alis, as seen lying in its cell. The limbs are folded close to the body in the most compact way possible. On the head of the semi-pupa, *i. e.* a transition state between the larva and pupa, there are two prominent tubercles situated behind the simple eyes, or ocelli; these are deciduous organs, apparently aiding the insect in moving about its cell. They disappear in the mature pupa.

Fig. 2.

Fig. 3.

Fig. 4.

Fig. 2. Larva of *Andrena vicina* Smith.
Fig. 3. Pupa of *Halictus parallelus* Say seen from beneath.
Fig. 4. Larva of *H. parallelus*.

To those accustomed to rearing butterflies, and seeing the chrysalis at once assuming its perfected shape, after the caterpillar skin is thrown off, it may seem strange to hear one speak of a "half-pupa," and of stages intermediate between the larva and pupa. But as we have before stated on page 429, the external changes of form, though rapidly passed through, consisting apparently of a mere sloughing off of the outer skin, are yet preceded by slow and very gradual alterations of tissues, resulting from the growth of cells.* An inner layer of the larva-skin separates from the outer, and, by changes in the form of the muscles, is drawn into different positions, such as is assumed by the pupa, which thus lies concealed beneath the larva-skin. But a slight alteration is made in the general form of the larva, consisting mostly of an enlargement of the thoracic segments, which is often overlooked, even by the special student, though of great

*On page 429, line 5, we say, "the changes though rapid are gradual." It should read, the changes (*i. e.* actual moultings) are rapid, though the steps that lead to them are gradual.

interest to the philosophic naturalist. Special attention has been drawn to this "semi-pupa" state by Ratzburg, in his "Development of Footless Hymenopterous Larvæ," and by Professor Agassiz, in his "Classification of Insects from Embryological Data" (Smithsonian Contributions), wherein he refers to the changes of the caterpillar of a butterfly (*Eudamus Tityrus*), just before assuming the chrysalis or pupa state.

From Mr. Emerton's observations we should judge, that the pupa state lasted from three to four weeks, as the larvæ began to transform the first of August, and appeared during the last week of the same month as perfect bees.

Andrena vicina is seen as late as the first week in September, and again early in April, about the flowers of the willow. It is one of the largest of its genus and a common species.

Having, in a very fragmentary way, sketched the life-history of our Andrena, and had some glimpses of its subterranean life, let us now compare with it another genus of solitary bees (*Halictus*) quite closely allied in all respects, though a little lower in the scale.

The *Halictus parallelus* Say, excavates cells almost exactly like those of Andrena; but since the bee is smaller, the holes are smaller, though as deep. Mr. Emerton found one nest in a path a foot in depth. Another nest, discovered September 9th, was about six inches deep. The cells are in form like those of Andrena, and like them are glazed within. The egg is rather slenderer and much curved; in form it is long, cylindrical, obtuse at one end, and much smaller at the other. The larva (Fig. 4) is longer and slenderer, being quite different from the rather broad and flattened larva of Andrena. The body is

rather thick behind, but in front tapers slowly towards the head, which is of moderate size. Its body is somewhat tuberculated, the tubercle aiding the grub in moving about its cell. Its length is nearly one-half (.40) of an inch. On the pupa are four quite distinct conical tubercles forming a transverse line just in front of the ocelli; and there are also two larger, longer tubercles on the outer side of each of which an ocellus is situated. Figure 3 represents the pupa seen from beneath.

Search was made on July 16th, when the ground was hard as stone for six inches in depth, below which the soil was soft and fine, and over twenty cells were dug out. "The upper cells contained nearly mature pupæ, and the lower ones larvæ of various sizes, the smallest being hardly distinguishable by the naked eye. Each of these small larvæ was in a cell by itself, and situated upon a lump of pollen, which was the size and shape of a pea, and was found to lessen in size as the larva grew larger. These young were probably the offspring of several females, as four mature bees were found in the hole." The larva of an English species hatches in ten days after the eggs are laid.

Another brood of bees appeared the middle of September, as on the ninth of that month (1864) Mr. Emerton found several holes of the same species of bee made in a hard gravel road near the turnpike. When opened, they were found to contain several bees with their young. September 2d, of this year, the same kind of bee was found in holes, and just ready to leave the cell. It is probable that these bees winter over.

We have incidentally noticed the presence in the nests of Andrena and Halictus of a stranger bee, clad in gay, fantastic hues, which lives a parasitic life on its hosts.

This parasitism does not go far enough to cause the death of the host, since we find the young of the parasitic *Nomada*, or Cuckoo-bee, in cells containing its young.

Mr. F. Smith, in his "Catalogue of British Bees," says of this genus: "No one appears to know anything beyond the mere fact of their entering the burrows of *Andrenidæ* and *Apidæ*, except that they are found in the cells of the working bees in their perfect condition: it is most probable that they deposit their eggs on the provision laid up by the working bee, that they close up the cell, and that the working bee, finding an egg deposited, commences a fresh cell for her own progeny."

He has, however, found two specimens of *Nomada sexfasciata* in the cells of *Eucera longicornis*, the Long-horned bee. He also states, that while some species are constant in their attacks on certain Halicti and Andrenæ, others attack different species of these genera indiscriminately. In like manner another Cuckoo-bee (*Cœlioxys*) is parasitic on *Megachile* and *Saropoda; Stelis* is a parasite on *Osmia*, the Mason-bee; and *Melecta* infests the cells of *Anthophora*.

The observations of Mr. Emerton enable us still farther to clear up the history of this obscure visitor. He found both the larva and pupa, as well as the perfect bee, in the cells of both genera; so that either both kinds of bee, when hatched from eggs laid in the same cell, feed on the same pollen mass, which therefore barely suffices for the nourishment of both; or the hostess, discovering the strange egg laid, cuckoo-like, in her own nest, has the forethought to deposit another ball of pollen to secure the safety of her young.

Is such an act the operation of a blind instinct? Does it not rather ally our little bee with those higher animals

which undoubtedly possess a reasoning power? Its *instinct* teaches it to build cells, and prepare its pollen mass, and lay an egg thereon. Its *reason* enables it, in such an instance as this, when the life of the brood is threatened, to guard against any such danger by means to which it does not habitually resort. This instance is paralleled by the case of our common Summer Yellow-bird, which, on finding an egg of the Cow-bunting in its nest, often builds a new nest above it, to the certain destruction of the unwelcome egg in the nest beneath.

In the structure of the bee, and in all its stages of growth, our parasite seems lower in the zoölogical scale than its host. It is structurally a degraded form of Working-bee, and its position socially is unenviable. It is lazy, not having the provident habits of the Working-bees; it aids not in the least, so far as we know, the cross-fertilization of plants,—one great office in the economy of nature which most bees perform,—since it is not a pollen-gatherer, but on the contrary is seemingly a drag and hinderance to the course of nature. But yet nature kindly, and as if by a special interposition, for which the Developmentists will find it difficult to account, provides for its maintenance, and the humble naturalist can only exclaim, "God is great, and His ways mysterious," and go on his way studying and collecting facts, leaving to his successors the more difficult task, but greater joy of discovering the cause and reason of things that are but a puzzle to the philosophers of this day.

The larva of *Nomada* may be known from those of its host, by its slenderer body and smaller head, while the body is smoother and more cylindrical. Both sexes of *Nomada imbricata* and *N. pulchella* of Smith were found by Mr. Emerton, the former in both the Andrena and

Halictus nests, and both species were found in a single Andrena nest.

The interesting history of the Oil-beetle (*Meloë*) and its wonderful transformations, and of the Stylops and other bee-parasites, cannot now detain us. We hope to lay an account of them before our readers at some future time.

THE LAND SNAILS OF NEW ENGLAND.

BY EDWARD S. MORSE.

(Continued from page 547.)

THE genus Succinea, of which we have three marked species in New England, is furnished with a thin, translucent, and elastic shell. The soft parts resemble those of Helix, but the creeping disk is quite short and broad, and the tentacles are short and swollen at their bases. The shell is entirely unlike Helix, being ovate-conic, and not rolled in a plane.

SUCCINEA TOTTENIANA. (Fig. 46.) Shell ovate, amber-colored, thin, translucent, shining. Whorls about three, the last very large; spire not prominent, suture distinct. The aperture is three-fourths the length of the shell, and so open that the animal when contracted within the shell is plainly visible. Length of shell from $\frac{5}{8}$ to $\frac{3}{4}$ of an inch. The animal is of a salmon-color, and the shell is sufficiently translucent to reveal the color of the viscera within. This species appears to be confined to New England and the Provinces. It is represented in the Western States by *S. obliqua*, a heavier and larger shell. It occurs in woods and fields. Sometimes found in great numbers in the roadways after a heavy dew.

Fig. 46.

Succinea avara *Say.* (Fig. 47.) The shell of this species is smaller than the preceding, being only a quarter of an inch in length. The spire is quite long, and the aperture is only half the length of the shell. The whorls are three in number, very convex, separated by a deep suture. The color is greenish or grayish straw. The surface of the shell is usually covered with a coating of dirt, accumulated by the fine hairs that stud its surface. This character alone is sufficient to distinguish the species. Common in damp woods.

Fig. 47.

Succinea ovalis *Gould.* (Fig. 48.) Shell very thin, pellucid, pale horn-color, polished, elongate. Spire short; aperture expanding in front. Length less than half an inch. The shell is quite elastic, and so translucent that all the organs are plainly visible, and the pulsations of the heart are distinctly seen. The animal is amber-colored, mottled with black dots. Inhabiting the Northern and North-eastern States. This species appears to be confined to the margin of pools in wet grass, and is often found clinging to the leaves of aquatic plants in ponds.

Fig. 48.

The following species belong to a genus of which there are but two species, one belonging to this country, and the other to the old world. The two resemble each other very much, and are regarded as the same species by many.

Fig. 49.

Zua lubricoides *Stimpson.* (Fig. 49.) Shell cylindrical, oblong, smooth, and brilliantly polished; transparent, smoky horn-color. Whorls five or six, rounded. Length $\frac{3}{10}$ of an inch; aperture oval; lip thickened; animal bluish-black. The shell is about the size of a grain of wheat. Its usual haunt

is beneath decaying leaves in forests, though it is found in grass, and under stones by the roadside. In some places the species occur in great numbers.

It is distributed throughout the Northern, Middle, and Western States.

The next species forms another genus under the name of *Zoögenetes*. It was first described as a Helix by Say.

ZOÖGENETES HARPA *Say*. (Figs. 50, 51.)* Shell ovate conic, light horn-color, very thin and elastic. Whorls four, convex, the last two marked by thin prominent ribs; suture distinct; aperture nearly circular; lip sharp. Length $\frac{1}{8}$ of an inch, animal slate color, mottled with light dots.

Figs. 50, 51.

This species forms one of the few exceptions among land snails, in which the young are brought forth alive. They are hatched from eggs, but the eggs are retained within the parent when this process takes place. The adult never contains more than four or five at a time, and it is a curious sight to break open this tiny shell under the microscope, and find within several young ones, those more advanced with little shells already formed. It is found in various parts of Maine, and is quite common in the vicinity of Portland in hard-wood groves. L. L. Thaxter has found it at Ascutney, Vt. It was first discovered in the North-west Territory, and between these two regions has rarely been met with.

The next group of species to be described have long cylindrical shells, and are among the smallest of our land snails.

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* We are indebted to the Smithsonian Institution, Washington, D. C., for the use of Figs. 50, 51.

The first that we shall describe is PUPILLA BADIA *Adams.* (Fig. 52.) The shell is oblong, cylindrical, having six or seven rounded whorls; color light brown, faintly striated, aperture nearly circular; the lip is thickened. Length $\frac{1}{8}$ of an inch. Prof. Adams first described this species from Lake Champlain, and stated that the aperture contained a tooth on the body whorl. Specimens from Maine have no such character. Mr. C. B. Fuller first discovered this species in Maine. It is extremely common in certain places in the vicinity of Portland. Mr. W. C. Cleveland has found it on Oak Island, Chelsea, Mass. This species is also ovoviviparous, that is, it brings forth its young alive.

Fig. 52.

PUPILLA FALLAX *Say.* (Fig. 53.) Shell oblong, having six convex whorls, which taper from the base to the apex, forming a pointed spire; aperture rounded, bordered by a broad white lip; umbilicus minute; color light brown, distinctly striated. Length $\frac{1}{5}$ of an inch; animal black; upper tentacles long and slender. Occurring in the Northern, Middle, and Western States, also in South Carolina. This can hardly be considered a New England species, as but few places have been noted where it occurs. Adams speaks of its being found in Vermont, and Mr. Thaxter has found the dead specimens in Woburn, Mass.

Fig. 53.

Those who have collections of minute land shells, would do well to provide themselves with a good magnifying glass, with the help of which they would be able to make out the species from the figures given.

NOTE.—The smaller figures accompanying the larger ones, indicate the natural size of the shells.

REVIEWS.

Observations on the Glacial Phenomena of Labrador and Maine, with a View of the Recent Invertebrate Fauna of Labrador. By *A. S. Packard, Jr., M. D.* With two Lithographic Plates. (From the Memoirs of the Boston Society of Natural History, Vol. I. Part 2.) pp. 94, 4to. Boston, 1867.

The author gives a sketch of the topography and geology of the coast of Labrador, followed by a special account of the drift or glacial phenomena in Labrador and Maine, describing four epochs in the history of the post-tertiary, or quaternary period: —

1. The true glacial epoch, during which Labrador and New England stood five hundred or six hundred feet higher than at present, and huge glaciers extended down to the sea from the various water-sheds. New England and Labrador, in other words, presented along their seashores "a nearly solid front of glacial ice, at least rivalling in height and breadth the enormous glacier 1,000 feet thick, and 540 miles long, discovered by Sir James Ross, in the antarctic lands."

2. *The Leda Clay*, or our common brickyard clays, during which epoch the land slowly sank, and the glaciers retreated up the valleys of the various water-sheds, leaving behind them the thick deposit of clay, gravel, and boulders which now covers the surface of New England. "During the slow and gentle submergence of the land ushering in this epoch, the crude moraine matter (heaps of stone and gravel borne upon the surface of the glaciers) was sorted into beds of regularly stratified clays one hundred to three hundred feet in thickness." — "An arctic fauna and flora inhabited the coast between the sea and the low snow-line, and the flora and fauna which are now found only on our Alpine heights, or in cold, isolated spots on the coast of Maine and the Northern lakes, then peopled the surface of New England and Canada."

3. "Period of raised Beaches (*Saxicava Sands*), during which the land emerged to its present elevation, and the fauna and flora assumed their existing relations. The close of this period witnessed the surface of New England covered by broad lakes and ponds, with vast rivers and extensive estuaries, and deep fiords cutting up the coastline. Its scenic features must have resembled those of Labrador at the present day."

4. The Terrace Epoch marks the period subsequent to the more general recession of the sea during the preceding period, when the estuaries and deep bays were contracting to their present size.

From the fossils found at various localities in Labrador, Canada, and

New England, it is inferred that the distribution of marine animals on the shores of North-eastern America "was governed by the same laws as at the present day. In going southward from Labrador to New York the seas became warmer the more they came in contact with the heated waters of the Gulf Stream, whose influence was evidently exerted on the coast of New England during the Glacial Period." The climate of New England was not purely arctic, like that of Greenland, but rather subarctic like that of Labrador, while now it is much warmer, being "boreal," or north temperate.

These studies on surface geology have attracted and always will attract much attention. Especially interesting is the occurrence of fossils in our clay and sand deposits, and we beg our readers to carefully preserve all shells and bones and other remains which may be found in making excavations for roads or wells. We are liable to discover in these deposits the bones of the mastodon, the elephant, the walrus, bison, and various species of whales. It is not improbable that the horse will be found to have lived in New England during the Terrace Period, immediately succeeding the disappearance of glaciers, and in fact every thing is to be determined regarding the distribution of life during these dark ages, either immediately preceding or accompanying the appearance of man on the earth.

The work closes with a catalogue of the marine animals dredged along the coast of Labrador, with descriptions of over twenty new species. The plates are beautifully executed, illustrating rare and interesting fossils from the Leda clays, and living forms of shells, worms, and crustaceans, with a geological map of that portion of the coast visited by the author. — A. H.

THE QUARTERLY JOURNAL OF SCIENCE. London. October, 1867.

We run hastily through the October number. Mr. Alfred Wallace, in "Creation by Law," reviews the Duke of Argyll's "Reign of Law." A very attractive plate represents an imaginary species of Hawk-moth (Sphinx) fertilizing by moonlight the flowers of an orchid growing in the forests of Madagascar, whose long, slender nectary hangs down twelve inches. Wallace argues that "the splendor of the humming-birds, is directly connected with their very existence." The most gaily-colored males are preferred by the more homely females, "which would lead to the individuals so adorned having more than the average number of offspring," adding, that "Mr. Darwin has lately arrived at the wonderful generalization that flowers have become beautiful solely to attract insects to assist in their fertilization." He adds, "I have come to this conclusion from finding it an invariable rule, that when a flower is fertilized by the wind, it never has a gaily-

colored corolla." — Cuthbert Collingwood writes on the Luminosity of the Sea. — Our Field Clubs, their Aims, Objects, and Work, notices the existence of institutions which have but recently started into growth, and seem as popular in England, as the Essex Institute in its summer dress seems to be in our Essex county. There, as with us, such meetings result in a wide diffusion of a taste for Natural History, and the managers of such meetings should bear in mind that "the excursion programme should in every case be drawn up with due consideration for the predilections of incipient naturalists." The Liverpool Naturalists' Field Club has 720 members. Its president states, "Large numbers join our excursions who are not particularly interested in any branch of natural science, and this is just what the chief object of our club renders a desirable circumstance. Special trains are made up, and journeys often of 160 miles a day, at a cost, including a substantial dinner-tea, of about seven shillings each, allowing five hours for work at the localities visited," give rest, recreation, and instruction to hundreds. During the past few years, the Institute Field Meetings have been deservedly popular in Essex county, from five hundred to two thousand persons attending them, and have done much to popularize scientific, historical, and antiquarian research.

From the Chronicles of Science, we learn that "India seems likely to be able to supply the whole world with quinine; for not only was the American supply uncertain, it was actually threatened with extinction, owing to the reckless way in which the Indians killed the trees in the process of stripping, planting, of course, no new ones." — M. Naudin believes that "monstrous" plants may become new species. A Poppy "took on a remarkable variation in its fruit, — a crown of secondary capsules being added to the normal central capsule. A field of such poppies was grown, and M. Göppert, with seed from this field, obtained still this monstrous form, in great quantity. Deformities of ferns are sometimes sought after by fern-growers. They are now always obtained by taking spores from the abnormal parts of a monstrous fern, from which spores ferns, presenting the same peculiarities, invariably grow." — "The Earl of Selkirk throws great doubt on the received creed as to the secular rise of land in Scandinavia." — Dr. Landois and W. Thelen show that there is an apparatus for closing the tracheæ of insects, which apparatus is often so developed, as to serve as a vocal organ.

The interest in the "Glass Rope controversy," regarding the nature of this very curious and remarkably elegant sponge or polyp, supposed to have been an artificial Japanese product, has been heightened by the alleged discovery of a European *Hyalonema*, or "Glass

Rope," off the coast of Portugal.—Dr. Pigeaux "believes that never, or quite accidentally and rarely, does the hare breed with the rabbit. The so-called Léporides are true rabbits, and not hybrids at all. The belief in the existence of such a hybrid was prevalent among the ancients."

Additional evidence has been obtained from the exploration of Kent's Cavern, Devonshire, that man was a contemporary with the mammoth, in the British Isles.—Messrs. Wistaw and Burk state that "falcons and hawks act as nature's police, and check the spread of disease and epidemics amongst birds, by killing off the weakly individuals of a covey."

Dr. Anton Dohrn, believes that all crustacea, insects, and arachnida. can be traced to a single parent form, which they each reproduce at one or the other period of development. This form is identical with the larva of Cirrhipedes (Barnacles); and he gives it the name of *Archizoëa*. But do insects pass through the form of a young barnacle? Without committing ourselves to Darwinian views, should we not rather look upon the *worm* as being the archetypal form of articulates, as they all assume this state in the course of development? Dohrn's *Archizoëa*, or articulate prototype, with better reason, we would suggest, takes on a worm-like form.—Mr. Wallace has published a most interesting paper "On the Relation between Sexual Differences of Color and Nidification in Birds."—"He runs over in detail the principal species of birds, having the female as beautiful and brilliant, or as conspicuous as the male. In cases where the female has this conspicuous appearance, the nest always conceals the female, and in cases where the female is of a dull color, the nest exposes a considerable portion of the sitting bird. When the male bird is less brilliant than the female, it is found that the male performs the duties of incubation. There thus seems to be a connection between the color of the different sexes of birds and the sitting over the eggs. There are some exceptions to this generalization, but they can be easily explained, for these are generally protective colors. Mr. Wallace considered that Darwin's principle of natural selection most aptly explained this connection of color and nests."

THE NATURALIST'S NOTE BOOK. London. January—October, 1867.

This journal culls from all departments of Natural History, forming a common-place-book of selections, and is a very entertaining monthly. Our contributors will be pleased to know that a dozen or more of articles from the AMERICAN NATURALIST appear in its pages with due credit.

Bee keepers will examine with interest Mr. J. Lowe's "Observa-

tions on Dzierzon's Theory of Reproduction in the Honey-bee," read to the London Entomological Society.

With a view to test the truth of the theory that "all eggs which come to maturity in the two ovaries of a queen-bee are only of one and the same type, which, when they are laid without coming in contact with the male semen, become developed into male bees; but, on the contrary, when they are fertilized by male semen, produce female bees," from which theory, if true, we might, in the words of Von Siebold, "expect beforehand that by the copulation of a unicolorous blackish-brown German and a reddish-brown Italian bee, the mixture of the two races would only be expressed in the hybrid females or workers, but not in the drones, which, as proceeding from unfecundated eggs, must remain purely German or purely Italian, according as the queen selected for the production of hybrids belonged to the German or Italian race," the writer set to work to obtain hybrids between *Apis mellifica* and *Apis Ligustica*, and also between *Apis mellifica* and *Apis fasciata*, and the result of his experiments was that Ligurian queen-bees fertilized by English drones, and Egyptian queen-bees fertilized by English drones, both produced drones which, as well as the workers, were hybrid in their characters, and bore unmistakable evidence of the influence of the male parent. From this the author drew the conclusion that the eggs of a queen-bee which has been fertilized by a drone of another race, whether they develop into drones or workers, are in some way affected by the act of fecundation, and that both sexes of the progeny partake of the paternal and maternal character or race; from which it followed that Dzierzon's was not the true theory of reproduction in the honey-bee. Specimens of the hybrids were exhibited to the meeting; and Mr. F. Smith (who did not consider *Apis Ligustica* to be specifically distinct from *Apis mellifica*), after an examination of the specimens, corroborated Mr. Lowe's statement that the hybrid drones distinctly showed characters peculiar to *Apis mellifica* in combination with the characters which distinguish *Apis Ligustica* and *A. fasciata* respectively.

NATURAL HISTORY MISCELLANY.

ZOÖLOGY.

THE DODO.—Mr. George Clarke, of Mauritius, has discovered a large deposit of bones of the Dodo in the swamp known as the "Marcaux Songes." By this now celebrated discovery the whole skeleton of the Dodo has been made known, excepting the end of its wing; whereas before the head and foot at Oxford, the skull at Copenhagen, the foot in London, and the beak at Prague, were all the specimens known of the bird.—*Quarterly Journal of Science, London.*

SINGULAR VARIETY OF THE FIELD SPARROW.—On the 12th of October, I shot a very singular variety of the Field Sparrow (*Spizella pusilla*) Baird. It was precisely similar to the ordinary form of that bird, except that its tail was pure white; with the exception, however, of the second and third exterior feathers, which were of the usual color. So marked a variety in a bird that generally presents very slight variations in color is so remarkable, that I consider it worthy of especial notice.—T. MARTIN TRIPPE.

THE GIGANTIC BIRDS OF THE MASCARENE ISLANDS.—With the Dodo were associated a large Parroquet, the Solitaire, the Géant (*Gallinula gigantea* Schlegel), and the *Porphyrio* (Notornis?) *cærulescens* Schl., which last is as large as a full-sized goose, blue, with the beak and feet red. It could not fly, but ran with great swiftness.

We figure from Schlegel's account in the French Annals of Natural Science, 1866, the "Géant," so called by its discoverer, Leguat, who saw this bird in 1694, since which time it has disappeared. It is allied to the Water Hens, and was six feet high; its body was as large as that of a Goose, white, with a reddish spot under the very small wings.

The "Géant," 1-20 the natural size.

These singular birds characterizing the land fauna of these islands, of which Mauritius is the largest, seem like the gigantic birds of New Zealand, as Schlegel remarks, to have replaced the mammals, of which these two groups of islands are destitute, and thus explains why these most characteristic birds are so peculiar in their size and structure. These birds were destroyed as early as 1700 by the European settlers, the cats and dogs, and the maroon Negroes. The Dodo and Solitaire are figured in Dana's Manual of Geology.

THE EAGLE A FISHER.—The American bald eagle (*Haliâetus leucocephalus*) belongs to the group of fishing-eagles, as might be inferred from the name of the genus, which is derived from *hals* (sea), and *a-et-os* (eagle); whence *Hal-i-a-et-us* (and less properly in science, the poetic form Haliæetus), a name applied to the osprey by the Greeks. The spelling "Haliætus" and the pronunciation "Haliâetus" are erroneous.

The East Indian *H. ponticerianus* is known to be a fisher, and the South African *H. vocifer* is called "the fishing-eagle" at the Cape of Good Hope.

The mode in which the bald eagle pursues and robs the fish-hawk is well known from the description of Alexander Wilson, which has been often quoted, as in the fourth volume (p. 92) of Harper's School and Family Readers, by Marcius Willson, who, however, has interpolated the words "as he is not a fisher himself." In my "Notes on Willson's

Readers" (1864) I state that the bald eagle, "with wings nearly closed, darts headlong into the water for his prey, in the general manner of the fish-hawk."

There was an eagle's nest high up on a large buttonwood (*Platanus*, ignorantly termed sycamore in some localities), on an island in the Susquehanna, about ten miles above Columbia, Pennsylvania, and in sight from my father's house, about a mile distant, where I had abundant opportunities to observe the fish-hawk, and the eagle robbing him; but sometimes failing to secure the fish, because its possessor dropped it before the eagle was near enough to seize it in its fall toward the water or the ground: for in the latter case, which was rare, I have observed the eagle to turn away without attempting to seek the fish on the earth.

When there are no fish-hawks to depend on, the eagle fishes for himself, taking the fish (if I remember rightly) with the feet, and leaving the water with apparent difficulty, and a good deal of flapping, which accords with the habits of the East Indian species. — S. S. HALDEMAN, *Columbia, Pa.*

MICROSCOPY.

STUDENTS' MICROSCOPE. — We call the attention of our readers to the advertisement of the Students' Microscope, manufactured by the Boston Optical Works. The stand is solid and very convenient, while the lenses are excellent. It is the best and cheapest microscope for general use for the physician and beginner in microscopy now in the market.

EXCHANGES.

Dr. Hermann Loew, of Meseritz (Posen), Prussia, is very desirous of obtaining fresh and well-preserved specimens of North American Diptera. They are very necessary for the completion of his work on the North American Flies, now publishing by the Smithsonian Institution. He will send very fine specimens of European Coleoptera to any Entomologist who will furnish specimens of Diptera in exchange. Packages may be sent through the Smithsonian Institution, Washington, D. C.

EXPLORATIONS.

Mr. W. H. Dall, of the Scientific Corps of the Western Union Telegraph Company, Russian Extension, writes from St. Michaels, R. Am., Aug. 14, 1867: "I have travelled in winter, with the thermometer from 8° to 40° with dog sleds and snow-shoes, about 300 miles; and

in the summer just past, I have paddled 650 miles up stream under the scorching northern sun, and 1,300 down stream in open canoes. I have made the first trip from Fort Youkon to the sea by the river Youkon ever made, and have geological notes of the whole of this distance, and have collected about 4,550 specimens, including some 300 or 400 birds and mammals, and have got, I hope, some fine new species of white fish.

ANSWERS TO CORRESPONDENTS.

R. A. S., Wisconsin. — The worm you send came dried up and impossible to identify. It is probably an *Ascaris*, one of the round intestinal worms. Among the best works on the Microscope are Carpenter on the Microscope, published by Lea & Blanchard, Philadelphia; Queckett's Treatise on the Microscope, London; L. Beale's How to Work with the Microscope, Philadelphia: J. Hogg on the Microscope, London; P. H. Gosse's Evenings with the Microscope, New York. D. Appleton & Co.

W. H. S., Hummelstown, Pa. — The shells appear to be robust specimens of *Physa ancillaria*, Say. The "worm-like animals" are the larvæ of the Caddis-fly, or Case-worm (*Phryganea*,) whose larva constructs a case of leaves, or bits of twigs and sticks. The other specimens were young Cray-fish, *Cambarus Bartoni*, commonly found in brooks in the Middle and Southern States. We have found this or an allied species hiding under stones on the edges of cold ponds in northern Maine. On the Aroostook River, they did great damage by undermining a dam, at or near Presque Isle. The Cray-fish has undermined the levee at New Orleans and vicinity, and been instrumental in producing devastating floods on the banks of the Mississippi.

Some spiders have the power of spinning their threads to a great length, which float in the air (the wind drawing the threads from the spinnerets), and catch on adjoining objects, serving as foundations for a web.

A. E., Maryland. — Your Myriapod, which you say "has appeared at this place (Ecton, Md.) within a few years past, and has infested many houses," is the *Cermatia forceps*, Wood. It is found sparingly throughout the Eastern, and especially the warmer parts of the United States. Scarcely anything is known regarding its habits.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

American Association for the Advancement of Science.—Natural History Section. *Burlington, Vt., August* 21–26, 1867. "On the Zoölogical Affinities of the Tabulate Corals." By Professor A. E. Verrill. Coral-like forms were stated to be formed by various kinds of animals, and also by some plants. Thus we have Protozoön corals (*Eozoön*, *Polytrema*, stony sponges, etc.); Molluscan corals (*Bryozoa*); Hydroid corals (*Sertularia, etc.*); Polyp corals (*Gorgonia, Tubipora, Madrepora, etc.*); Vegetable corals (*Nullipora, Corallina*).

Although there are still some doubtful groups of corals, the nature of most forms is now well known. The most important doubtful groups are at present the Cyathophylloid corals (*Rugosa* Edw.), and the Tabulate corals. Nearly all authors place both these great groups among the true Polyps, but a few advocate the Molluscan affinities of some of the Cyathophylloids, and certain genera of the Tabulata (*Chætetes, etc.*), the former being compared with Hippurites, etc., and the latter with Bryozoa.

Professor Agassiz has, however, referred both these groups to the Hydroids, placing them, therefore, in the class of Acalephs. As both are abundant in the Silurian rocks, this generalization carries the appearance of the Acalephs back from the Jurassic to the Lower Silurian period. Therefore this becomes a question of importance both in Geology and Zoölogy. The Cyathophylloid corals being entirely extinct, their real affinities may, perhaps, long remain in doubt. The Tabulata, however, are still represented in tropical seas by several genera and numerous species.

Professor Agassiz examined the living animals of Millepora several years ago at Florida, and in his "Contributions" has figured and described them, showing them to be genuine Hydroids, the different-sized cells being occupied by different sorts of individuals, comparable to the different kinds of individuals in the communities of various other Hydroids. From these observations, upon a single genus, he has concluded that all other Tabulate corals, living and fossil, are also Hydroids. In the hope of throwing some light upon this question, Mr. F. H. Bradley was requested, while collecting at Panama for the Yale College Museum, to examine, if possible, the living animals of a species of *Pocillipora* found at that place, a coral belonging to the Tabulata, but to a family (*Favositidæ* Edw.) differing in many characters from Milleporidæ. According to his descriptions and drawings, the animals of Pocillipora have all the external appearances and structure of a true Polyp, closely resembling those of Porites. They are

exsert when expanded, and have twelve equal cylindrical tentacles surrounding the margin in a single circle, six of them being held horizontally, and the alternating ones erect. This peculiar posture was the principal difference observed between these animals and those of *Porites*, when compared side by side.

From the disagreement in the character of the animals of *Millepora* and *Pocillipora*, in connection with great differences in the corals, it is necessary to refer the former to the Hydroids, while the latter must remain with the true Polyps. It is probable that *Favosites*, and many other extinct tabulated genera belong with *Pocillipora*, while *Heliolites*, etc., may go with *Millepora*. Therefore we must regard the Tabulate structure as a character of secondary importance and the artificial group of *Tabulata* must be dismembered.

"On the Coal Measures of Illinois, with a vertical section of the Strata." By A. H. Worthen, State Geologist. In the prosecution of the Geological Survey of Illinois, it seemed desirable to identify our coal-seams with those of the Kentucky section, inasmuch as the Illinois and Kentucky coal-field was known to belong to the same basin; and with this end in view, a general examination of our coal-measures was made by Professor Lesquereux, and the results were published in the first volume of the Illinois Report. Subsequent investigations showed that the conclusions arrived at in regard to the position that the main coal-seams occupied in the Illinois section, especially those recognized as the equivalents of Nos. 5–9 and 11, of the Kentucky section, were erroneous, and that if that section was correct, no parallelism could be made out between the coal-seams of the two States.

In order to determine correctly the sequence of the coal strata, as they are developed in Central and Northern Illinois, a section was constructed the present season along the valley of the Illinois River, which traverses the coal-field from south-west to north-east, for a distance of about one hundred miles. This section shows the development of six beds of workable coal, together with four or five thin coals, varying from a few inches to two feet in thickness, and the whole are enclosed in about five hundred feet of measures immediately above the conglomerate. This includes all the workable coals at present known in the State. By comparing the Illinois with the Kentucky section, we found a general correspondence in the lower part of each, but nothing in the Illinois section to correspond with the *Anvil Rock Sandstone* and the beds intervening between that and the *Mahoning Sandstone*. Taking these beds from the Kentucky section we have a general agreement between the two. Hence we were led to conclude that in constructing the section in Kentucky, a single

sandstone, outcropping at different localities, had been mistaken for two different beds, to one of which the name of Anvil Rock was given at one locality, while at the other it was called Mahoning Sandstone, and in this way their section was increased in thickness about three hundred feet or more beyond what it really should be, and the number of workable coal-seams nearly doubled.

This view of the case is strengthened by the fact also of a general correspondence between the upper portions of the two sections, both of which are characterized by several thin seams of coal, of little or no value in consequence of the thinness of the strata, while the limestones in this part of the Illinois section are characterized by a group of fossils recognized by Professor Meek as common in the upper coal-measures of Kanzas, and as the equivalent of beds to which the term "*Permo-carboniferous*" was applied by himself and Dr. Hayden in their paper on the rocks of Eastern Kansas.

Again, by placing these sandstones on a parallel, and giving a downward section for three hundred feet as given in the Kentucky section, and we have an almost equal repetition of beds.

If we take the Kentucky section as published, and place these sandstones on a parallel, we find an almost exact repetition of the strata for 300 feet below, and from these facts we are forced to conclude that the Anvil Rock and Mahoning Sandstones are identical, and that the section should be shortened by extracting from it all the strata composing the first-named Sandstone, and the beds supposed to intervene between it and the lower bed. This gives a general correspondence between the Illinois and Kentucky sections, such as might be expected to occur in different portions of the same coal-field.

"On the Lower Silurian Brown Hematite Beds of America." By B. S. Lyman. Some thirty exposures of brown hematite, in Smyth county, South-western Virginia, are found by a rough topographical survey to belong apparently to the outcrops of four ore-beds, conformable to the Lower Silurian rocks of the region. At three or four exposures the solid ore-bed is to be seen; at the others only loose lumps of ore mixed with loam.

The other American brown hematite deposits of the same age, resemble these so closely as to leave the impression that where only loose lumps of ore occur, mixed with loam or other materials, they are always mere rubbish that has been accumulating near the outcrop of regular beds ever since the denudation began; similar to the loose blocks of sandstone near the outcrop of a sandstone bed, or to the coal-dirt of a coal outcrop, or to gold or tin alluvial deposits, making allowance of course in the comparison for the characteristic

hardness and heaviness of the brown hematite, and for the thickness of its beds. The ore lumps would be mixed not only with the rubbish of neighboring rock-beds, but with the remains of plants that grew during the accumulation of the ore-lumps, such as the Brandon and Mont Alto lignites. Lumps of carbonate of iron, found in some such deposits, go towards showing that the ore was originally a carbonate, and afterwards altered as the coal-measure carbonates so often are. The author thought these lumps were not concretions.

"The Winooski Marble of Colchester, Vermont." By C. H. Hitchcock. Rough and polished specimens of a beautiful marble, obtained from localities less than six miles from Burlington, were exhibited. It belongs to the lower part of the Potsdam group, and is a silicious dolomite. It contains nodules of calcite enclosing amorphous silica, which render the stone more difficult to saw than statuary marble. The prevailing color is some shade of red, with variations of white, brown, chocolate, and yellowish tints.

"The Distortion and Metamorphosis of Pebbles in Conglomerate." By C. H. Hitchcock. In this paper the doctrine was advanced that the pebbles of certain conglomerates had been very much distorted since their deposition as a coarse sediment, and that in some the chemical character had been altered by metamorphism, so that fragments, originally an impure limestone or a schist, had become changed into quartz. The process had probably been carried so far in some instances specified, that the original sandstone and conglomerates had been converted into schists, gneiss, and granite. The agents producing these changes were thought to be the chemical action of infiltrating mineral waters intensified by the immense pressure, accompanied by a slight plasticity of the pebbles, perhaps no more than is implied by a thorough warm aqueous interpenetration of the masses. Every case described was in a highly disturbed region, where numerous plications in the strata had been observed. Where it was possible to trace a band of rock from a crumpled to its normal position, it was noticed that in the undisturbed state the mass was simply a loosely cemented coarse gravel, with round pebbles; but where folds abounded, the stones had been indented, flattened, and bent, and the cement had become crystalline. Localities were noticed from Middleton, R. I., Bellingham, Mass., Washington County, Mount Battie, and Sandy River Plantation, Me., East Wallingford, and Plymouth, Vt., the Nagelflue in Switzerland, and the Permian conglomerate in England, etc. The opinions of eminent European geologists in favor of a superinduced distortion were quoted, as well as the experiments of Mr. Sorby, illustrating the greater efficiency of chemical action under pressure.

"The Geology of Vermont." By C. H. Hitchcock. A large geological map of this State was shown, illustrating the great advance of our knowledge of its rocky structure since the publication of the author's map in the Final Report upon the Geology of Vermont in 1861. The additions to our knowledge were largely afforded by the extension southerly of the recent discoveries of the Canadian survey.

"Explanation of a Geological Map of Maine." By C. H. Hitchcock. The author exhibited a large geological map of Maine, prepared from the materials gathered during two years work in the service of the State in 1861, 1862.

BOSTON SOCIETY OF NATURAL HISTORY. *October* 2, 1867.—The President exhibited a series of Flint instruments from the Island of Regan, and from Norway and Sweden, consisting of arrow and spear heads, square cut chisels, etc. One was a hatchet with a circular hole for the insertion of the handle, the interior of which was smooth and the diameter uniform. Mr. Rau, the Danish Consul at New York, had shown how these holes might be drilled, by boring half through a paving stone with a rotating broomstick and sand. A few implements representing saws and knives, and one, undoubtedly used as a dagger, but resembling a large spear-point, were among the articles exhibited; most of them were unlike anything found in this country.

Dr. Wyman further gave an account of a recent visit of a party of members of the society to shell-heaps upon Goose Island, in Casco Bay. The objects exhumed were mostly similar to those found at Mount Desert, and described by Dr. Wyman at a previous meeting. Among the most interesting were bones, apparently of the Great Auk, a bird now extinct on our coast.

Mr. Edward S. Morse called attention to the evidences of great antiquity in the shell-heaps upon Goose Island. The deposits consisted of large beds of broken clam-shells, with other species intermixed. Over five hundred square feet of surface had been examined, and the absence of any metal and singular scarcity of stone implements were noteworthy. The heaps, which thickened towards the centre, covered areas of from ten to fifteen feet in diameter, and showed an outcrop on the bank of from two or three to fourteen or fifteen inches in height. Since in many cases heaps of this magnitude had been almost wholly washed away, an extensive erosion of the bank must have taken place since the formation of the deposits. Coupled with this fact, Mr. Morse observed one place where the erosion of the bank had exposed the surface of a rock smoothed and scratched by glaciers, and sufficient time had elapsed to erase nearly all these marks from the hard rock. He also remarked that the shell-heaps appeared to rest on

the primitive soil; the turf covered the heaps to the depth of six or seven inches, while there were no traces of soil below. The land-shells, such as *Helix Sayii*, *indentata*, *multidentata*, and others, remains of which were found in the lower portions of the heaps, can only exist in hard-wood growths. The portion of the island where these heaps occur is at present covered with large spruce growth. The Quahog, found plentifully in these heaps, is extremely rare in Maine. Thus we have a change of vegetation, a change of certain species of animals, an evidence of extensive erosion of the banks, an absence of articles that we would be likely to find in deposits of recent formation, all indicating extreme age. Hundreds and perhaps thousands of years may have elapsed since these heaps were commenced. The Danish archæologists regarded similar heaps in Denmark as being older than the stone age — in fact, as among the earliest evidences of the presence of man.

A short discussion ensued upon the probability that the shell-heaps rested upon the primitive soil. Mr. Scudder wished to know what had become of the vegetable mould which must have supported the hard-wood growth, beneath which the land-shells, found at the bottom of the shell-heaps, lived. Dr. Pickering believed that vegetable mould would disappear after the lapse of ages by the action of the elements, and Dr. Jackson spoke of the chemical means by which this could be brought about.

Papers were read by Dr. H. Hagen, Mr. P. R. Uhler, and Mr. S. H. Scudder, on the Dragon-flies of the West Indies.

Lyceum of Natural History. *New York*, *April* 29, 1867. — Mr. C. F. Hartt gave an account of the glacial phenomena about Rio Janeiro, observed by him while a member of the late Thayer Expedition, from Cambridge, under Professor Agassiz. He dwelt at much length on the glacial phenomena exhibited about Rio, which he traced as far north as Bahia, but which Professor Agassiz has claimed to have seen on the Amazon. "Everywhere," said the speaker, "the gneiss hills are rounded evenly down so as to present all the appearance of '*roches moutonnées*,' and immediately over their surface, and clinging closely to it, is a sheet of quartz pebbles, sometimes large, rounded boulders, more or less thick (occasionally absent), following all the curves of the surface, and sometimes found on slopes where the material could never have been deposited by water, and where it is only held in place by a superincumbent sheet of red sandy clay, very variable in thickness, such as would result from the mechanical grinding up of the gneiss. This clay shows no evidence of the sorting action of water, the felspathic clay, broken quartz grains and mica crystals

being all present. It contains occasional angular and rounded fragments of quartz, sometimes of gneiss or some other material, scattered through it."

This drift-sheet was described as extending from the Sierras down over the tertiary deposits occupying the low grounds along the shore. The speaker mentioned the existence of cretaceous beds near Bahia, some fish remains which he found having been identified as cretaceous by Professor Agassiz, and he spoke of the evidence of recent changes of level along the Brazilian coast. He had examined the stone reefs at Pernambuco, Bahia, St. Cruz, and Porto Seguro, and described them as sea beaches which had been solidified by the lime of sea-shells, and which, having been separated from the shore by the encroachment of the sea, now extend along it like linear walls of rock. At Porto Seguro he discovered quite an extensive reef of coral, which he was able to trace southward to the Abrolhos Islands. This reef he saw at a very low tide exposed off Porto Seguro over an area several miles long. The corals grow up sometimes in isolated clumps like mushrooms, and the natives call them *chaparoens*. He spoke of the interest attaching to a still further exploration of this reef, for it is an entirely new ground, and would certainly afford some new and interesting facts to science. He announced that it was his intention to spend his summer vacation on the Abrolhos, taking with him a party, which he hoped would be fitted out by the new Natural History Section of the Cooper Institute.

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THE INSECTS OF ANCIENT AMERICA.

BY S. H. SCUDDER.

UNTIL within a very few years not more than four or five kinds of fossil insects had been found on this continent. Indeed, little thought had been bestowed upon their possible discovery, and while hundreds of eager students had carefully examined the living insects, few turned to the ancient representatives of this class upon the globe. New and interesting discoveries have thrown some light upon the insect-life of Ancient America, but even now, the known species, occurring in many localities and in various deposits, will not number one hundred different kinds.

The discovery of the oldest insect remains in the world is due to Mr. C. F. Hartt. While collecting fossil plants in the Devonian slates near St. John, New Brunswick, he first perceived faint traces of insects' wings. Few persons would have noticed these insignificant relics, but Mr. Hartt having discovered a single insect, thoroughly examined all his rock specimens until six other fossils were brought to light. In the more carefully gleaned fields of

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Europe, a few species have been found as low down as the Carboniferous rocks of Wetterau, Saarbrück, etc., but these fossils from the Upper Devonian carry the first appearance of insect-life back to a previous epoch, and make their advent in North America synchronous with that of land plants.

The specimens obtained by Mr. Hartt are intrinsically interesting; although they are all fragments, broken generally from the centre of the wing, enough distinctive parts remain to determine the character of the fossils. They are all Neuroptera, or Lace-winged flies, and, with the exception of one or two Ephemerina, or May-flies, represent families which are now extinct. One of them is provided with a few veins forming concentric rings near the base of the wing; these rings bear such a striking resemblance to the stridulating organ of the green grasshoppers, that I am inclined to believe there were chirping Neuroptera in those days!

Similar in interest are some specimens of Neuroptera from the Carboniferous beds of Morris, Illinois; they occurred in small flattened iron-stone concretions, like the clay-stones in clay banks of the present day. These Neuroptera also represent families distinct from any now living, and, like many of the Devonian insects, are synthetic in character; that is, combine in one and the same form features which, in after ages, are distributed among the members of different families. In this case the synthesis unites families belonging to different sections,—some to Neuroptera proper, others to Pseudo-neuroptera. The Neuroptera proper include those families where the pupæ are inactive, and the limbs are folded against the body; such as the Sialina, Hemerobina, Mantispadæ, Panorpina, and Phryganina (Caddis-flies). In the Pseu-

do-neuroptera—classed by some naturalists with Orthoptera—the pupæ are active and are provided with rudimentary wings; otherwise they differ but little from the larvæ: among them are the Termitina (white ants), Psocina, Perlina, Ephemerina (May-flies), and Odonata (Dragon-flies). Had these insects of former days active or inactive pupæ?

Two other remains were found in these iron-stone concretions; they appear to me to be those of worms, but naturalists have described one form as a centipede, the other as a caterpillar of a moth; the caterpillar was referred to the family of Arctians, to which our woolly caterpillars belong. The last, if true, would be a most interesting discovery; for in Europe only one moth, and that of the lowest family, the Tineids (of which the clothes-moth is a member), has been found as low down as the Jurassic period.

Dr. Dawson, of Montreal, has been quite fortunate in discovering various kinds of insects in the coal-beds of New Brunswick and Nova Scotia; traces of the mining of larvæ were found on the leaf of a fossil fern, and this was the more remarkable because ferns in our day are peculiarly exempt from attack by mining insects. Among the fossil remains were numerous fragments of Myriapods, which had secreted themselves in the trunks of decayed trees; coprolites of the reptiles which had sought shelter in the hollow trunks proved that the animals fed partially, at least, upon insects,—they were filled with comminuted fragments of the bodies and limbs of Orthoptera and Neuroptera of large size, and, in one instance, Dr. Dawson found the eye of a dragon-fly.

Professor Marsh, of New Haven, has also obtained an insect's wing at the Joggins in Nova Scotia; he thought

it similar to a cockroach's wing found by Professor Lesquereux in the Carboniferous rocks of Frog Bayou, Arkansas, but it was put away at the time of its collection, and has never since been examined. Mr. Barnes has just discovered a wing of a similar kind in the coal formation of Pictou. There has been but one other instance—and that of very recent date—where a fossil insect has been found in the Carboniferous rocks of this country; it was the case of a single wing, gigantic in size, peculiarly veined, and probably allied to our May-flies, which occurred in the coal-beds of Cape Breton, Nova Scotia.

Professor Hitchcock, in his examination of the footprints in the New-Red Sandstone of the Connecticut Valley, described and figured some small tracks which he supposed to have been made by insects; but the footprints of insects have been little studied, and the whole subject is so difficult in its nature, that it would be an arduous task to prove whether the tracks were made by insects or not. In the shales accompanying the New-Red Sandstone, however, quite a large number of insect remains have been found, all of which belong to the larva of a single species. Professor Hitchcock believed them to be neuropterous, but I think they should be referred to the Coleoptera, or beetles. The species must have lived in the water, since the specimens are comparatively numerous; on a small slab I have counted more than twenty individuals.

Professor William Denton has obtained the largest collection of fossil insects which has yet been made in this country. The specimens were brought from an uninhabited region beyond the Rocky Mountains, near the junction of the White and Green Rivers, Colorado,—a deposit probably far richer than that of Œningen, in Switzerland. Professor Denton was able to obtain but

few specimens while passing rapidly through the country, but he describes the shales in which they occur as a thousand feet thick, varying in color from a light cream to inky blackness, and crowded with the remains of insects and leaves of deciduous trees. Between sixty and seventy species of insects were brought home, representing nearly all the different orders; about two-thirds of the species were flies,—some of them the perfect insect, others the maggot-like larvæ,—but, in no instance, did both imago and larva of the same insect occur. The greater part of the beetles were quite small; there were three or four kinds of Homoptera (allied to the tree-hoppers), ants of two different genera, and a poorly preserved moth. Perhaps a minute Thrips, belonging to a group which has never been found fossil in any part of the world, is of the greatest interest. At the present day, these tiny and almost microscopic insects live among the petals of flowers, and one species is supposed by some entomologists to be injurious to the wheat; others believe that they congregate in the wheat, as well as in the flowers, in the hope of finding food in the still smaller and more helpless insects which congregate there. It is astonishing that an insect so delicate and insignificant in size can be so perfectly preserved on these stones; in the best specimens the body is crushed and displaced, yet the wings remain uninjured, and every hair of their broad, but microscopic fringe, can be counted.

The specimens came from two localities about sixty miles apart, called by Professor Denton Chagrin Valley and Fossil Cañon; these two faunas are apparently quite distinct: the ants, the moth, the thrips, nearly all the small beetles and the greater part of the flies come from Fossil Cañon, while the larvæ are restricted to Chagrin Valley.

While no definite conclusion can be drawn concerning the age of the rocks in which these remains occur, there can be little doubt that they belong to the Tertiary epoch. Professor Denton believes them to be at least as old as the Miocene.

The species of fossil insects now known from North America, number eighty-one: six of these belong to the Devonian, nine to the Carboniferous, one to the Triassic, and sixty-five to the Tertiary epochs. The Hymenoptera, Homoptera, and Diptera occur only in the Tertiaries; the same is true of the Lepidoptera, if we exclude the Morris specimen, and of the Coleoptera, with one Triassic exception. The Orthoptera and Myriapods are restricted to the Carboniferous, while the Neuroptera occur both in the Devonian and Carboniferous formations. No fossil spiders have yet been found in America.

EXPLANATION OF PLATE 16.

Fig. 1. *Miamia Bronsoni.* A neuropterous insect found in ironstone concretions in the Carboniferous beds at Morris, Illinois. The figure is magnified one-third, and has all its parts restored; the dotted lines indicate the parts not existing on the stone. Reduced from a figure in the Memoirs of the Boston Society of Natural History, Vol. I.

Fig. 2. *Archimulacris Acadica.* Wing of a Cockroach observed by Mr. Barnes in the coal-formation of Nova Scotia.

Fig. 3. *Platephemera antiqua.* A gigantic May-fly obtained by Mr. Hartt in the Devonian rocks of New Brunswick.

Fig. 4. *Xylobius sigillariæ.* The Myriapod (or Gally-worm) found in the coal-formation of Nova Scotia, by Dr. J. W. Dawson. Copied from a figure in Dr. Dawson's Air-breathers of the Coal-period. Magnified.

Fig. 5. *Lithentomum Hartii.* A neuropterous insect, the specimen first discovered by Mr. Hartt in the Devonian rocks of New Brunswick. This fossil, and those accompanying it, are the oldest insect-remains in the world.

Fig. 6. Three facets from the eye of an insect, considered by Dr. Dawson a Dragon-fly. It was found in coprolites of reptiles in the

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

Fig. 5.

Fig. 6.

Fig. 7.

Fig. 8.

SCUDDER ON FOSSIL INSECTS.

rocks containing the myriapod, represented in Fig. 4. Copied from Dr. Dawson's figure, greatly magnified.

Fig. 7. *Homothetus fossilis.* A neuropterous insect from the Devonian rocks of New Brunswick; it was discovered by Mr. Hartt.

Fig. 8. *Haplophlebium Barnesii.* A curious neuropterous insect, of large size, probably allied to our May-flies; taken by Mr. Barnes from the coal of Cape Breton.

These figures, with the exception of 1, 4, and 6, are of life size, and borrowed from the new edition of Dr. Dawson's Acadian Geology.

THE HAND AS AN UNRULY MEMBER.

BY BURT G. WILDER, M. D.

(Concluded from page 491.)

Fracture or Crossing. This is the name given to a view of the limbs, which, under various modifications, has been entertained by four celebrated anatomists, Bourgery, Cruveilhier, Flourens, and Owen. Its essential feature is the pronation of the forearm so as to bring the thumb on the inner side, opposite the great toe; but this has the effect of crossing the radius upon the ulna, so that its upper end is to the outer, while its lower end is to the inner side of that bone. This condition of things, though contrary to the relation of the corresponding parts in the leg, is accepted by Owen* and Flourens, who simply seek to show that the front of the arm really corresponds to the front of the leg, and *vice versa*, so that the concavity of the elbow is made to represent the convexity of the knee; but the other two anatomists try to explain the crossing of the bones, upon an idea which was distinctly enunciated by Cruveilhier, in the following propositions:

"1. Neither bone of the leg is represented by a single bone of the arm.

*Comparative Anatomy of Vertebrates, ii. 310, 360.

"2. In each bone of the leg we find characters which belong, partly to the ulna, and partly to the radius."

The practical result of this view is to cut the two bones across the middle, and reunite the upper half of the one with the lower half of the other; a convenient and ingenious, but unjustifiable mode of procedure.

Fig. 1.

Torsion. This last of the three principal theories adopted, or rather invented, in support of the idea of parallelism, was first proposed by Maclise, in 1849. Like all the rest, he assumes that the thumb corresponds with the great toe; that the hand points forward like the foot, and that the limbs are, or ought to be, parallel: but he saw that his predecessors had been unable to fulfil these three conditions without pronating the hand, and so crossing the radius upon the ulna, which crossing he could not reconcile with the fact, that the corresponding bones in the leg (Plate 12, fig. 1)* were parallel with each other. He then perceives that the *front* of the forearm really corresponds with the *back* of the leg, and *vice versa;* whereas, according to the idea of parallelism, the front of the one ought to correspond with the front of the other, as believed by Owen and Flourens. To reconcile this new fact with the old theories, he reminds us that "anatomists have long since remarked upon the singular *twisted* form of the humerus," and then says, "this

*Fig. 1. The right arm as it appears after having been *untwisted*, as proposed by Maclise and Martins. The bend of the elbow is brought to the front, and the two bones of the forearm are parallel. This is in the effort to bring corresponding points of the two limbs to face in the *same* direction. Compare with Plate 12, Fig. 1. The real *symmetrical* view of the limbs requires simply that the forearm be *supinated*, and the thumb left on the outer side like the little toe.

fact of torsion in the shaft of the humerus I consider as fully explaining the above-mentioned peculiarities which distinguish the upper from the lower member; while (in idea) I untwist the humerus by bringing its back to the front, I at the same time unravel the gordian knot of that problem which has so long existed as a mystery for the homologist."

But, before accepting this ingenious solution of the problem, you may be inclined to ask how it is, that, if the humerus is really twisted, anatomists have never observed and described the various stages of the operation, instead of simply commenting upon the *twisted appearance* of the bone. This very reasonable question is thus answered by a French anatomist, Martins, who in 1857, and apparently unacquainted with the views of Maclise, proposed this very same theory of torsion.

Martins admits as a "metaphysical difficulty," the fact that the humerus *never undergoes* the actual operation of twisting at all, and that in the earlier stages of growth *not the slightest traces of torsion exist;* but asserts, nevertheless, that "a *virtual* torsion does take place during growth, and that this produces the same effects as if it were real." The chief indication of this is the raised line for the attachment of muscles, which runs obliquely upward, from the outer side of the lower end of the humerus, and is lost upon the posterior surface, giving to the lower part of the bone the *appearance* of having been twisted. But it may be seen that the posterior surface of the thigh bone presents a similar raised line, even more strongly marked, so that there is quite as much reason for untwisting that bone, which would leave matters relatively just as unconformable as at first; and it is well known that both these lines are solely for the attachment

of muscles, that they do not exist in young or feeble individuals, and that in some animals, as in the ant-eater, and even in the horse, they form prominent ridges which can never be accounted for by any twisting of the bones.

There is really a fourth theory of parallelism, modifications of which are entertained by three eminent English anatomists,* and which is, in many respects, the most plausible and the most difficult to refute. According to this view the limbs are supposed to stand out at right angles from the side of the body, the elbow being moved forward and outward, and the knee backward and outward into a position which nearly corresponds with the condition of the limb in many reptiles, and also in the early stages of growth of the higher animals; and in view of the great weight which is now deservedly attached to the facts of embryology, it will be evident that such a view must not be rejected without very good reasons. It will be noticed, too, that this view does little violence to the limbs, although the limbs of mammalia would be placed in rather uncomfortable positions, in order to conform to it. I feel sure, nevertheless, in spite of the apparently natural arguments, and in all deference to its distinguished advocates, that it is based upon a partial consideration of the subject, and I wish that it were possible in this connection to offer my reasons for dissenting therefrom. But it involves so much, and would require a discussion of so many still controverted points, that I should be obliged to present in full the grounds upon which my own opinion is founded, which would far exceed the limits of an article like this.†

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* Huxley, Mivart, and Cleland, before cited.

† Those of my readers who care to learn the views of the anatomists who believe in a symmetrical or antagonistic relation of the limbs are referred to the works of the "Oppositists," already cited in the preceding number, and the following papers by the writer: On Morphology and Teleology, June 3, 1866, Memoirs Boston

And to do this was by no means my object, but simply to give an idea of the trouble which has been given philosophical anatomists by the hand; for, as has been shown, the hand suggests an idea of parallelism which it is very difficult to overlook, so that the majority of those who have treated this subject, have made more or less ingenious attempts to apply the same principle to the upper portions of the limbs.

These various attempts have been briefly, though I think fairly stated. What seem to me their fallacies have been brought more prominently into view and criticised as severely as possible, partly on the abstract ground that a great step in our investigation of truth is the full recognition and rejection of error; and partly, in accordance with the purpose of this paper, to show what strange and widely diverse opinions have been entertained by those who have regarded the Hand in its ordinary position, and with the common estimation of its value.

The space allotted to me will permit only the briefest presentation of the grounds upon which is based the other view, that, namely, of a symmetrical or antagonistic relation between the fore and hind limbs; the principal point is, that instead of beginning with the *hand*, and forcing the rest of the limb to conform to it, we should recognize that the hand is a peripheral organ and subject to variation;* and that its morphological value is by no means equal to its teleological or functional value; and that, finally, the attitude which it has in most animals is

Soc. Nat. Hist., Vol. I. No. 1; On a Cat with supernumerary digits, Proc. Boston Soc. Nat. History, May 16, 1866; and on the Morphological value and relation of the Hand (Abstract of a paper read before the National Academy of Sciences, August 8, 1866), American Jour. of Sciences and Arts, July, 1867.

*No one, so far as I know, has recognized this inverse ratio between the morphological and teleological values of organs. And yet its non-recognition seems to me not only to have blinded the eyes of the Parallelists to the idea of symmetry which underlies the antagonistic relation of the proximal segments of the limbs, but also to have prevented most of the Oppositists from carrying out this idea beyond the elbow.

in consequence of the necessity for the extremities of both pair of limbs to strike the ground so as to propel the body in the *same* direction : but if we begin with the upper parts of the limbs, we shall perceive an idea of *antagonism* which may be easily traced in the hands when they are put in what may be termed their *normal position* (Fig. 2) ;* and although this brings the thumb on the outer side, and thus opposite the little toe, yet if we recollect that in most animals the thumb is rather *smaller* than the other digits, instead of larger as in man, and that therefore its assumed superiority is really confined within a very narrow limit, we may conclude, when the question comes, Shall the thumb force the arm and the forearm into parallelism, or shall it conform to the idea of antagonism which they suggest, that the latter is the fairer and more philosophical view of the matter.

It sums up thus. Begin your studies of the limbs at the periphery, with the hands and the feet, and assume a correspondence of thumb and great toe, you will then see an apparent parallelism as to the extent of which no two investigators can agree, and by which they have been led to twist, to fracture, and to dislocate the limbs in a manner most unjustifiable ; and to regard the body as a structure with but one end and no centre, a geometrical absurdity.

But commence at the centre, at the middle of the vertebral column, and regard the body as having not only two *sides* but two *ends*, antagonistic in position and in function ; then you will see that the limbs which are given off from the two poles of this longitudinal axis, are like-

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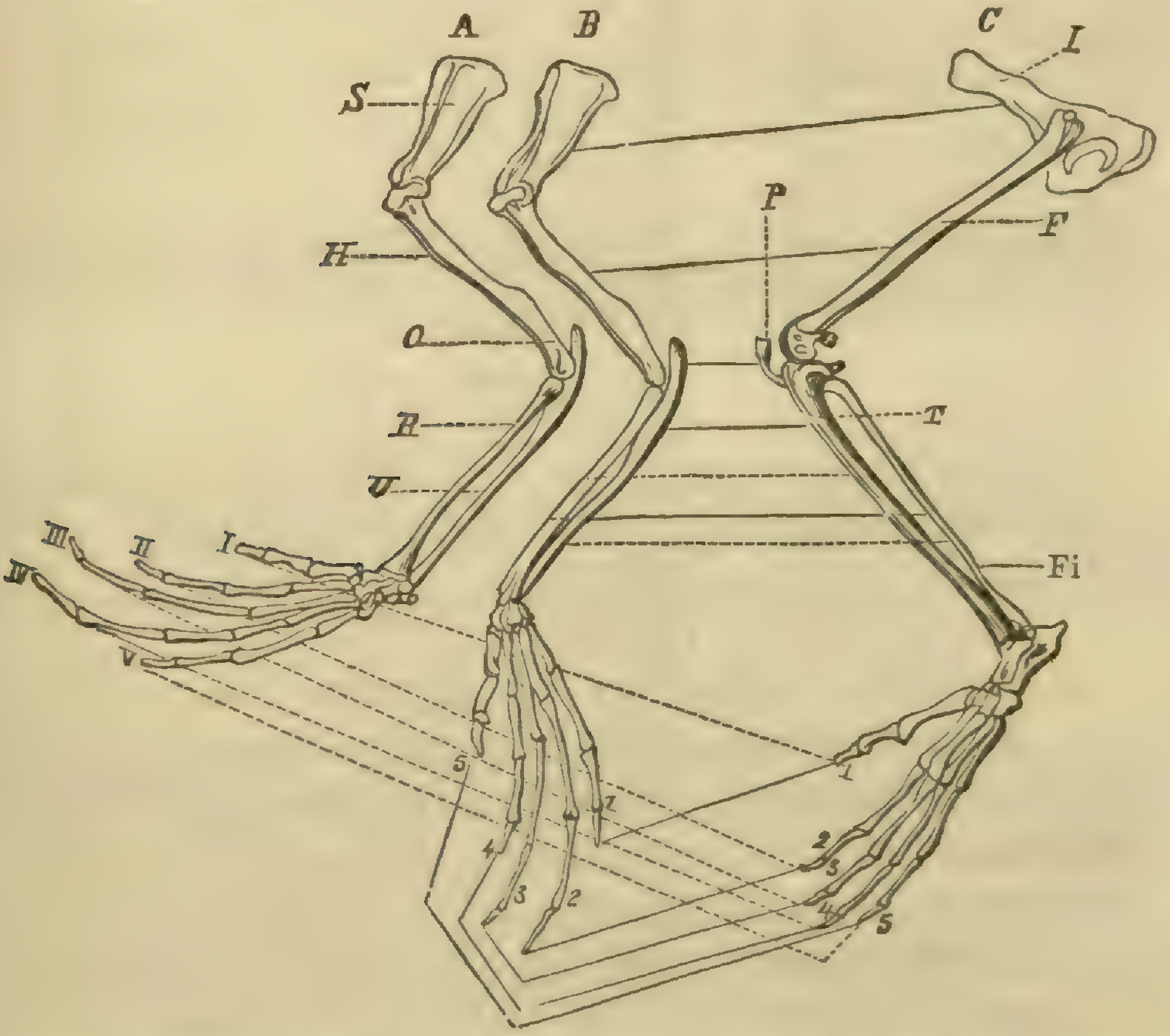
*Those of my readers who are unwilling to compare the fore and hind limbs in any other than a *natural attitude*, are reminded that there is no one natural attitude common to all vertebrates, or even to all mammalia, and are referred to what has been said upon the normal position of animals by Professor Agassiz. Contributions to the Natural History of the United States, vol. iii. p. 76.

wise antagonistic in every part but the terminal segments, while even these disagree only in what is the natural attitude of the hand in the forward moving animal, and come into a proper antagonistic relation in what may be con-

Fig. 2.



Limbs of left side of Aye-aye (*Cheiromys Madagascariensis* Cuvier), altered from Owen.* (By permission from American Journal of Science and Arts, July, 1867.) *A*, Foreleg in its *natural attitude*, the hand being more or less pronated, so as to bring the thumb (1) upon the inner border of the limb, and cross the radius upon the ulna. *C*, Hind-leg. *B*, foreleg in its *normal position*, the hand being supinated so as to bring the thumb (5) on the outer side, and opposite the little toe (5). The radius *R* is now wholly on the outer side of the ulna (*U*), and the fingers point backward, as the toes point forward. All the parts are now symmetrical with those of the hind-leg, and the parts thus *symmetrically homologous*, are joined by continuous lines; but the parts which are only *analogous* in the natural attitude of the foreleg, are joined by dotted lines. *S*, Scapula; *I*, Ilium; *H*, Humerus; *F*, Femur; *O*, Olecranon process: *P*, Patella; *U*, Ulna; *T*, Tibia; *R*, Radius; *Fi*, Fibula. The *homologous* digits of *B* and *C* are numbered 1, 2, 3, 4, 5, starting from the so-called little finger and great toe. The Roman numerals attached to the digits of *A* indicate their *analogies* with those of *C*.

* Monograph of the Aye-aye, Plate 7. Also, Comparative Anatomy and Physiology of Vertebrates, Vol. II. Fig. 343.

sidered its normal position. To all this, the thumb is the only objector; but mighty as that is in all matters of common life, you must already have perceived, by a kind of "reductio ad absurdum," that the less it, and, indeed, the whole hand are regarded in our morphological comparison, the less liable shall we be to fall into such extraordinary and fantastic notions as some of those we have been considering. Fortunately, however, man can but interpret Nature; he cannot change her. His errors die with his interpretation, while the facts belong to God, and are safe from the interference of man.

THE SOUTHERN MUSCADINE GRAPE.

BY D. H. JACQUES.

Climbing the tallest trees, covering and almost smothering the smaller undergrowth, hanging over rail fences, hiding pine stumps and brush-heaps, or, for want of other support, trailing on the ground, one may see almost everywhere in the South, from the seaboard of Georgia and Florida to the mountain slopes of North Carolina, the graceful vines of the Southern Muscadine, and, in its season, the ripened fruit, with which many of these vines are laden, will allure the traveller at every turn from the dusty road. Few who have once eaten this fruit, in its perfection, will be able to resist the temptation to dismount and eat the tempting clusters.

As this grape is not found (I believe) north of the southern slopes of the Alleghany Mountains, and is little known, and often erroneously described, a brief notice of it may not be out of place.

The Southern Muscadine, otherwise called Bullace, Bull, and Bullet-grape is the *Vitis Rotundifolia* of Michaux (*V. Vulpina* Linn.), and is very distinct from all

other species. Its light-brown slender wood, its innumerable small branches, thrown out tree-like rather than in the manner of other grape-vines, and its small, light-green shining leaves, give it a peculiar and singularly beautiful appearance. The following is a correct description of it:—Stem smooth, light-brown dotted with white, lithe, tough, and without pith; branches minutely verrucose, numerous, slender; leaves small, cordate (but somewhat rounded, whence Michaux's name); dentate,

sometimes obscurely three-lobed, glabrous, shining on both surfaces; flowers in racemes, composed of numerous small umbels; polygamous, yellow; berries large, black, musky sweet, with a tough skin; flowers in June; first ripe in September.

The Southern Muscadine produces its fruit in clusters of from three to eight berries, on small branches put out from all parts of the vine, and, if the soil and other conditions be favorable, is often very prolific. The berries vary in size, from half-inch to an inch in diameter. They are brown-black and shining when commencing to ripen, but a dull-black, dotted and sometimes blotched with red when fully ripe. They vary much on different vines, being sometimes hard and sour, but often tender and deliciously sweet. In the best specimens the pulp finally dissolves, and the skins become literally bags of wine. The fruit generally falls from the vine soon after it becomes ripe, but I have seen some vines on which the berries have clung with as much tenacity as in any other species. I have gathered bushels of these grapes during the present season, out of a portion of which I have made some excellent wine.

Professor Asa Gray, in one of his Botanical Text-books (see "Manual of Botany of the Northern United States," page 78), describes the Muscadine as the parent of the *Catawba* and the *Scuppernong*. The former is a variety of the *Vitis Labrusca*, or Northern Fox-grape. In regard to the latter he is correct.

The Scuppernong is a seedling of the Muscadine, and was found growing wild on the banks of the Scuppernong River in North Carolina. The wood is a shade lighter than that of the parent, but dotted like that, and the foliage and habits of growth of the plant are mainly the

same. The fruit is a pale green when fully ripe, and dotted with brown. It is large,—often an inch in diameter,—very sweet, less musky than the common Muscadine, and with a thinner and tenderer skin, and is a delicious table grape. For wine, it is superior to all other native varieties, being emphatically the wine-grape of America. Unlike other cultivated grapes, it is perfectly free from all diseases, no rot or mildew ever infecting wood, leaves, or fruit.

Flower's Grape is a black variety of the same species, and is thought by some to be equal, if not superior, to the white or green variety. It is sweet, juicy, and fragrant, and makes a fine wine of any desired shade of red. It ripens about a month later than the Scuppernong, and does not fall off like that variety. Both are enormously productive, so much so that I hardly dare to state how many bushels of fruit a single vine may bear; but from 2,000 to 3,000 gallons of wine per acre is considered a moderate estimate for a vineyard in full bearing, in which all the arbors are fully covered,—that is, when the whole ground is completely canopied with vines. The vines are planted from twenty to forty feet apart, and trained on arbors made with posts notched on the top, and supporting a layer of common fence-rails. This arbor is extended with the growth of the vine, till the ground is covered. The vines require no pruning, except for the removal of dead branches, or to improve their symmetry. A Scuppernong vineyard is worth a journey from Salem to Savannah to see.

Such is the Muscadine of the South and its offspring.

A VACATION TRIP TO BRAZIL.

BY C. FRED. HARTT, A. M.

New York to Para.

On the 22d of June, 1867, I left New York in the steamer "Havana" to spend my vacation on the Brazilian coast, my especial object being an exploration of the coral reefs of the vicinity of the Abrolhos Islands, and the study of the geology of such parts of the Province of Bahia as might be accessible to me. Nothing of note occurred on the voyage to the Island of St. Thomas, where the steamer was delayed a day to take in coal, and where I had an opportunity to make a good collection of corals, etc. A long account of my day's examinations having already appeared elsewhere,* I propose in this series of articles to take up my description of some of the more interesting results of my voyage after leaving the West Indies, and to offer a closing article on St. Thomas and the Windward Islands, in which I will incorporate new material collected on my return home.

Steamships have robbed the sea of half its poetry, and a voyage by steam is often very barren in incidents; so with this voyage, we have had no storms, no accident to break the monotony of our life at sea, so that our journals have not been much enriched by any very interesting experiences when out of sight of land. To be sure we have fished up gulf-weed, and collected the delicate little animals found growing on it, and we have watched the flying-fish and porpoises and whales; but one sees about as much of these things from a steamer, as he does of the cattle of a country he travels through by rail.

*N. Y. Tribune, Nov. 7, 1867,—"A Naturalist in the West Indies."

A word about the flying-fish. Of these there are many different kinds, not only belonging to different genera, but different families of fishes. The common flying-fish of the Atlantic belongs to the genus *Exocœtus*, a name given to the Mediterranean species by Aristotle, because it was currently believed by the ancients that the fish, spending the day in the water, flew out at night and slept ashore, whence the name which signifies *a sleeper out*. The common flying-fish somewhat resembles a pickerel, with a squarish head and body; but its pectoral or forefins are very long, and capable of being expanded like broad wings. The abdominal, or ventral fins, are rather large and irregularly fan-shaped. In the water the fish swims, as most other fish do, with the tail, the long fins being folded against the body. But, not satisfied with swimming, it seeks to imitate the birds, and ever and anon it leaps into the air, and takes short flights, sustained on its broad pectoral fins. Ordinarily the fish are seen to rise from the water near the ship, and glide off diagonally, almost in the direction she is going, and very often right against the wind. They rise at a very low angle, and keep close to the water. On rising, the tail is seen to quiver, sometimes beating the water for several yards, leaving a wake behind, and at the same time there is a very perceptible tremulous motion of the fins; but when once fairly in flight, the fins, both pectoral and ventral, are fully extended. The latter are held obliquely downwards, while the position of the former seems to vary very considerably. Usually the forefins are inclined a little upward, while the body is carried with the tail a little lower than the head. If there is a heavy sea running, the fish is seen to rise and fall over every wave without touching the water, and this is done apparently with as

much ease as if it were a bird. I have observed that the vertical inclination of the "wings" is varied considerably, and the vertical undulations of its flight appear to be directed by these fins. It has evidently no power of directing its lateral motions, although one might rather look for the use of the tail for that purpose. If the fish darts right against the wind, its flight may be in a straight line, ending by its pitching plump into the water, but if the course be oblique to the wind, it is soon blown aside. Of the thousands of flying-fish I have observed, I have never seen one tack up into the wind, unless it plunged into a wave and took a fresh start, as is not infrequently the case, when it darts into the water and out again, like an arrow shot through a wave. I have spoken of the flapping of the fins on rising; during the rest of the flight this is ordinarily not observed, their only motion being the gentle variation in inclination; but if the animal finds itself settling before its flight is finished, as soon as the tail touches the water, that fin is agitated, while there is a fluttering seen of the pectorals: should the fish rise again, the fluttering ceases. The fish seen rising near the ship are evidently frightened by her approach. Looking over her bows when the waves are not disturbed by minor undulations, one may see shoals of them darting irregularly about in the water. Sometimes they spring up suddenly in clouds. The bonito, sharks, and other fish prey on the flying-fish, and the latter, when attacked, leap out of water to elude their enemies. One day we saw a school of *bonitos* which were ever and anon leaping out of the water. Before them the flying-fishes were flying away like clouds of grasshoppers in advance of one walking through a grass field. Overhead whirled some large, graceful, white, long-tailed tropic birds (*Phaëton*),

which were engaged in catching the flying-fish as they rose, so that the poor little animals found themselves safe nowhere.

The distance flown by one of these fishes varies greatly, and depends much on the wind. They frequently go two hundred to three hundred feet without moving the fins, but the little ones never fly far.* In these cases, the fish glides through the air with an initial velocity, obtained by the action of its tail-fin before leaving the water, and the flight is no more like the flight of a bird, than is that of the flying-squirrel, or the Galæopithecus. I have had a few opportunities of witnessing the flight of flying-fish during calm weather, when I have then repeatedly seen the common Exocœtus fly more than a hundred yards, and, in two or three instances, I have seen what appeared to be a different species fly at least a thousand feet in *a horizontal line*, with a perfectly well seen continuous movement of the fins like a bird. The first specimen I saw I took to be a little bird, and I should never have known it to be a fish had I not seen it disappear in the water, and soon afterwards seen others rise near the ship. These observations were made near Barbadoes, and at the time there was not a ripple to disturb the glassy surface of the ocean waves. This *flying* species seemed to me to be quite different from the common Exocœtus, having broader and darker-colored fins; but I did not see it sufficiently clearly to enable me to speak confidently of other than its general appearance, as my attention was occupied with its flight. Was it not a *Flying Gurnard*, or *Sea Robin?* (Dactylopterus).

When but a short distance north of the Amazonas, on

* Some of the little animals which leap out of the water in shoals, and are often mistaken for flying-fishes, are cuttle-fishes.

the present voyage, I was surprised at seeing not far from the ship that the blue color of the sea turned abruptly to a bottle-green. We were evidently on the edge of a current, whose boundaries were as well defined as if the blue ocean water through which it flowed had been solid land. This was probably the outer edge of the current flowing northward along this coast. We struck it immediately, and soon entered it, when to my delight I found the difference in color was owing to an immense number of little jelly-like animals which swarmed there so as to destroy the transparency of the water. Just on the edge of the current these were collected together in the most astonishing quantities, but in the blue water a foot from the edge I did not see a single one, so sharply defined was the line marked. This line ran about E. S. E., and extended to the horizon on both directions, while the opposite side, if there were any, was not visible. Half the circle of the sea was ultra-marine, half bottle-green. As soon as possible I had a bucket lowered, and after many trials some of the animals were captured; I found them to be *Salpæ*, a low kind of mollusk, with small, gelatinous bodies, almost perfectly transparent, and growing in compound communities, which swim by taking water into the cavity of the body, and propel themselves by the reaction caused by the expulsion of this water, in the same way as the cuttle-fish swims. There is a very interesting law which obtains among many of the lower animals, called the *alternation of generations*, according to which the offspring is unlike its parents, but like its grandparents. These *salps* are good examples of this law, for one generation consists of compound communities, and the next of single individuals. Some of the chains were three or four inches in length, and the individuals of which they were composed of the size of a gooseberry.

On the surface of this current floated hundreds of beautiful "Portuguese men-of-war" (*Physalia*), and we saw in eddies on the edge of the current two or three fleets of several hundreds each, looking like beds of large pink flowers, on a smooth green lawn. They drifted thickly by us, their brilliant floats careening on the wave. Now and then they were overwhelmed in the great foam sheet that broke from the steamer's bow; but their upset barks soon righted themselves, and floated away on the foaming waves astern. As I looked down on their airy, bubble-like forms, anchored deep in the green water by their numerous cables, how I wished I could capture one, but from the high deck of the steamer it was hopeless to attempt it.

Fancy now a light bubble-like float, of a semi-transparent membrane, blown plumply out with air, and shaped somewhat like an egg laid on its side, with the upper part flattened into a sort of a crenulated, or, to use a milliner's term, "pinked" crest. Tint this float of a rosy hue, deepening it toward the crest, and color the lower part a warm violet, and you will have a faint idea of the beautiful float of the "Portuguese man-of-war," one of the most interesting members of the class of jelly-fishes. But this is not all; this is really only the float or swimming sac of a colony of animals which hang from the lower part down into the water, like gelatinous cords. Agassiz tells us that in this colony the sack is one animal developed for the special purpose of sustaining the colony in the water, and that of the others some are constructed for one purpose and some for another; some catch the food, but it is, figuratively speaking, to please the palate of others, while what one eats goes to nourish the whole colony.

Sailors will tell you that the animal is poisonous, and burns the hand. Every one who has been on the sea-shore

has seen a common jelly-fish, and some may know that some species have the power of stinging. Talk about nettles and stinging ivy! The first specimen of the Physalia I ever collected, I found one evening at dusk on the shore of Porto Seguro. It was half-buried in the sand, much wilted, and I took it to be a shell, *Ianthina*. I picked it up, and while examining it, the long tentacles slipped through my fingers, and brought very forcibly to mind that they were very plentifully armed with minute cells, in each of which was coiled an exceedingly fine thread, which, thrown out on the bursting of the cell when it is touched, penetrates the hand, and immense numbers thus wounding the nerves produce a very intense burning sensation, which, sometimes extending itself up the arm, as it did in this instance, causes acute suffering. He who once takes a living Physalia in his hand will not be likely to pick up another.

On the 10th of July we arrived off the mouth of the Para river, the southern mouth of the Amazons; but as it was impossible to enter the river and pass the shoals in the night, we stood across the mouth for the light at Salinas, on the southern bank of the river. We were to sight the light at eleven o'clock, P. M. At half-past ten the engine was slowed, a man was in the fore-top on the lookout, and with a friend I remained on the bow peering anxiously into the darkness ahead, as the steamer plunged cautiously over the big swell. A dim light, like the first ray of a rising star, is seen. "Two points on the weather bow!" cries the man on lookout. A moment after and the light flashes brightly out and disappears. It is the realization of a *saudade*,* and the heart is glad!

All night we killed time steaming up and down, wait-

*A word as dear to the Portuguese as our word *home*, and nearly as untranslatable. It has all the meaning of homesickness, but it also expresses a deep longing to see an absent friend, or some loved distant spot.

ing for the morning. Day broke with the land in sight, no grand blue serras lying cloudlike on the horizon, but a long, low stretch of trees level as the line of the sea. Here we are in the mouth of the Para, but only one side can be seen, and from the middle neither side is visible, for it is here thirty-three miles in width.

There are a number of extensive sand-banks in the mouth of the river which make it difficult to enter. The main channel lies between two of these banks, over which the waves break sometimes fearfully. This channel is not more than two miles in width. An experienced pilot of the Para is attached to the steamer. We passed up the channel early in the morning against the tide, with a fine view of the breakers on each side. Hitherto there has been nothing to mark this channel, but lately two buoys have been placed at the entrance. What is much needed is a lightship, for at present the entrance is impracticable by night. Steaming up the river we soon left the brackish water, and came into the turbid waters of the Amazonas, finding ourselves on what seemed to be a fresh-water sea. The water is very muddy, and of a light milky brown. This is the color of the main river of the Amazonas. When one looks at the mighty flood pouring steadily out of the mouth of the Para, and strives to calculate the amount of solid material it is bearing down from the land to the sea, he cannot but be amazed at the work the giant river is doing towards cutting away the continent, and in spreading it out anew over the bottom of the Atlantic. About one hundred miles from the mouth of the Amazonas, a small stream flows off southward, when it meets with the Anapa, Pacajos, and the great Tocantins, which last is sixty miles wide at its mouth, and swells into the Para, which Agassiz calls one

of the mouths of the Amazonas, though apparently it receives only a small part of its waters from the main stream.

By and by the opposite bank of the river makes its appearance, and we have on each side a long level line of trees rising from the water. Looking both up and down stream, a water-horizon is seen; still farther up large wooded islands come in sight, and these like the shores are flat, and only slightly elevated above the water level. Looking up among the islands, it appears like looking out to sea from a large bay. The banks are very heavily wooded. There are no clearings of any size visible, and there are only a few little huts seen nestled in among the trees. On the projecting points along the southern bank of the river are stations from which are displayed signal flags, to give notice at Para of our arrival. At length, ahead on the water-horizon gleams a white object, which seems to be a ship; but the opera glass shows it to be the tower of a church, and the pilot tells us that it is the cathedral of Para, but it seems out at sea. Soon other towers rise above the turbid horizon, and ere long there gleam in the afternoon sun the white buildings of the city of Para, the capital of the province of Gras Para. It seems like the work of enchantment. With the city in view, we run along close to the southern shore, passing a few fazendas, some tile-making establishments, a church or two, all backed by the dense Amazonian forest, that sheet of vegetation, which, almost unbroken save by rivers, covers the whole Amazonian valley like a sea, to the very foot of the Andes. At a distance the forest resembles our own hard-wood forests, only it is denser and more luxuriant. Once in a while a large round-topped tree is seen, blushing deeply with blossoms like the top of a thunder-cloud bathed in the red evening sun-

light; but the only feature that strikes the uninitiated eye as tropical in this scenery is the occasional slender, graceful curved stem of a palm, with its beautiful leaf and crown. The breeze comes to us warm and fragrant, and one breathes it in in long draughts. But now comes a clearing, and a low projecting tiled roof is seen nestled in among the heavy foliage. In front is a long line of cocoa palms. One sees the large, deep green, shining leaves of the Jaca, or bread-fruit (*Artocarpus integrifolia*), two species of banana and orange trees, and would never dream he was anywhere else than in the tropics. There is one palm seen here (*Mauricea*) which I do not remember having seen elsewhere in Brazil. It is a large palm, with immense ragged-edged, fan-shaped leaves. There are numbers of them on the shore just below Para. Meanwhile that we have been sweeping the shore with an opera glass, watching the little Chinese-looking boats, with their leather-colored cotton sails, or a little Brazilian sidewheel steamer, outward bound, we come up with a little fort, an old-fashioned, circular structure, built on a tiny island a few miles down the river. Over the parapet appears the mouth of an enormous speaking-trumpet, that hides the head of the officer who hails the ship:—

"*D'onde vem?*" (Whence come you?)

"New York," answers the Captain.

"*Quantos dias?*" (How many days?)

"Nineteen."

"*Para onde vai?*" (Where are you going?)

"Rio de Janeiro."

"*Boa Viagem!*"

At five o'clock we are anchored off the city, having consumed the day in ascending the river, a distance of seventy miles, for all the morning we had to stem the strong outflowing tide.

NOTES OF A FUR HUNTER.

BY HENRY CLAPP.

[When exploring the slate-bearing region of Maine last fall, I had occasion to employ as guide Mr. Henry Clapp, of Brownsville, Piscataquis county, of that State. His home is at the foot of the Ebeeme Mountains, which form the southern portion of a mountainous district, extending away north to, and including Mount Katahdin, a district well watered by the Penobscot and Upper Kennebec, and their streams, dotted with smaller lakes, and including also Moosehead Lake, Chesuncook, Joe May, and other large sheets of water. It is a country for a hunter to grow up and live in. In Mr. Clapp I found a man of life-long experience in this and other hunting-grounds, and at the same time an enthusiastic and careful observer, and one scrupulously exact in his statements. I had learned much from him about the mammalia of Maine, and one day when we were storm-staid, I took the following notes from his statements. I could easily rearrange them and enlarge upon them, but they seem to me to take their principal value from the fact, that they are a record essentially as given of an intelligent, experienced hunter's account of the results of his observations. — J. E. M.]

Panther, or Catamount (*Felis concolor* Linn.). I never saw a Panther, or Catamount. One night I found a deer bitten through the back. There were many tracks (not of deer) right about him, but I could not find any leading off from the spot. I think the beast jumped on to the deer from a tree. I heard his shrill screech, like that of a woman in distress. I heard the same screech and saw the same track again not far off. I think the animal was a catamount.

Lynx, or Loup-cervier (*Lynx Canadensis* Raf.). The Loup-cervier lives upon partridges, deer, rabbits, etc. It can climb trees. I have seen one in a tree. I have had one carry my trap with a heavy clog into a tree, and found him dead with it in the limbs. The animal is about

two feet or more high. They are quite numerous about here: one man caught nine within six miles of here. They are easily killed by a blow with a stick. I once found a fox's tail in a rabbit-path, with Loup-cervier's tracks about. I judged that the fox was going one way in the rabbit-path, and the Loup-cervier the other way, and the Loup-cervier sprang upon the fox and ate him, leaving his tail. They often go in families, five and six together. I met four one bitter cold day. They came on to the ice, not in single file, but right and left, and from four to six rods apart; and from examining their tracks, I judge this to be their habit. I think they travel in this way to scare up more game.

Wild-cat (*Lynx rufus* Raf.). The Wild-cat is not quite so large as the Loup-cervier. It has black rings around its legs; its fur is not so long as a Loup-cervier's; its foot is more like a dog's or house-cat's, the bottom of it being bare, while with a Loup-cervier it is covered with fur. Its leg is quite dark or black toward the foot. Its skin is not worth so much as that of a Loup-cervier.

Wolf (*Canis occidentalis* Rich.). I know little about Wolves. I have seen them, but never killed one. They often kill deer on the ice of the lakes; more on the ice, I think, than in the woods. I found one deer, which they had killed and skinned in such a way that I got a pretty good skin from it. They stripped it off so that it clung to the legs. It seemed to have been torn open along the belly. The meat was taken off, leaving only skeleton and skin.

Red Fox (*Vulpes fulvus*, var. *fulvus*). The Red Fox does not weigh as much as he appears to. His weight is about ten pounds. I have found but one that came up to eleven pounds, but have found a number that weighed

nine pounds. He lives on mice principally, also on beech-nuts, fowl, and rabbits. House-cat meat is good bait for them, so is honey, cheese, and pork scraps; and hog's liver is excellent. I make a bed as large as a cart-wheel, strew on ashes and chaff, and then get the foxes familiar with the place. I go there often myself, until they get so familiar with my track, finding it brings them no harm, that it does not scare them. A strange track, or mine, if I stay away a little while, would keep them off for a night or two. I cover my trap with ashes, which seems to prevent them from smelling it. I attach a grapple to my trap, so that when the fox runs off with it, it will catch and hold him before he goes far. I don't fasten it to the bed, because the digging of the fox caught would frighten away others. The fox is not so much afraid of the iron as of the man who handles it, and, therefore, I avoid touching the trap with my hand. If I have a dead horse, or other carcass, I throw it into a hollow where the snow will cover it. When the foxes have made a path to it, I set a trap in the path, covering it with snow from the carcass and the fox path, and making new tracks over it with a fox's foot if I have one. I don't touch anything about the trap with my hand, but use a wooden shovel. Sometimes I smear the trap with a mixture of tallow and fox dung.

Red Foxes are plenty about here. In 1865, I bought thirty-seven skins taken in the neighborhood. One Silver-gray Fox (*Vulpes Virginianus* Rich.?), was caught in Brownville or Milo, three or four years ago, and was sold for $35.00. I have seen one skin of the Black Fox (*Vulpes fulvus*, var. *argentatus?*). It was from Sangerville. There is also a kind called Cross-gray (*Vulpes fulvus*, var. *decussatus*), on account of a cross made by

dark color and gray. In 1865, Red Fox skins were worth $4.50 to $5.00. Last winter I paid $2.50 for them. I think they will be lower this year.

Fisher, or Fisher-cat (*Mustela Pennantii* Erxl.). The Fisher is much like the sable, but larger, weighing six times as much, say from eight to ten pounds, some more than this. They live on rabbits, partridges, squirrels, and berries, especially berries of the mountain-ash; they are also very fond of porcupines, the skins often having quills stuck in them, which, however, do not enter far into them. They also eat beechnuts. The Fisher runs with a "lope" and a jump; I never saw one trot. He leaves but two tracks, one a little farther forward than the other, thus, ·.   ·. , as do also the mink and sable. Sometimes they leave more, but the habit is to leave two. The color is dark-brown or gray. He nests in hollow pine stumps and ledges, I think. They are not very plenty about here. I caught seven last fall, and one this fall. The trap was set with bear's meat. I also caught a fox in the trap.

Sable (*Mustela Americana* Turton). The Sable is of about the size of the mink, a little larger, and with longer legs. Its color is red or yellowish. It lives on mice, squirrels, partridges, rabbits, beechnuts, and mountain-ash berries. It don't like porcupine meat as well as the fisher. It will eat fresh fish, but I don't think it catches fish. I catch them in a "dead-fall" trap, sometimes in a steel-trap. I catch them in the mountains north of here. They nest in hollow trees. I never saw a sable swim; I once thought I saw one swimming, but when I caught the animal, I found it to be a mink, with the sable's color. They are never very plenty about here. Price of skins last winter, $2.25 to $2.50; year before last, $3.50 to $3.75.

WEASEL (*Putorius*).* The Weasel lives principally upon mice; is said, I don't know how truly, to kill hens and partridges. Once I found that some duck feathers I had left in a camp had been dragged into a barrel of hard-bread by a weasel, for lining to a nest. I have had them so tame in the camp, as to come into my lap and eat fresh fish and partridge. They are brown in summer, and white in winter.

MINK (*Putorius vison* Rich.). The Mink is a sly, thievish creature. They eat fish and frogs. I have seen where they brought the frogs in to their young. The nest was under the roots of a tree. The color is black or dark brown; when shedding their coat, they are a little more reddish. We catch them in both "dead-falls" and steel-traps, baited with fresh fish; though they will take also muskrat, partridge, and red squirrels. They are not very plenty about here. Their skins are worth $5.00 to $6.00.

OTTER (*Lutra Canadensis* Sab.). I estimate the weight of a good-sized Otter at thirty pounds; their average weight is twenty-five to thirty pounds. They live on fish and muskrat. They dive down, and then rise into the passage way of the muskrat house, so as to push their jaws into the house and catch the muskrat, unless, as is sometimes the case, the muskrat has a second passage to escape through. The otter has no house, but lives in holes in the banks of streams, and in hollow logs, and under roots. His hind-foot is partially webbed; I don't remember about his fore-foot. He dives and chases fish under water. I saw one do this, and then shot him. He seems to like to slide instead of walking down a slope. He seems to have certain places for voiding his excre-

* Several species of this genus go under the general name of "Weasel."—EDS.

ment. Color, dark-brown or black. Legs very short; body and tail very long. He is a roving animal. The skin sells for from $6.00 to $8.00.

SKUNK (*Mephitis mephitica* Baird). The Skunk lives on locusts and crickets principally; will eat chickens and suck eggs. They are plenty about here. The skin is worth ten to fifteen cents, and has been worth fifty cents. I bait them with meat.

RACCOON (*Procyon lotor* Storr). The Raccoon is very rare about here. I have caught them in a "dead-fall," baited with fish. I have known them to go into the corn-fields and eat corn. The skin is worth from half a dollar to a dollar.

BLACK BEAR (*Ursus Americanus* Pallas). I don't think there are two species of bears in the country here, but the single species varies exceedingly in color and size and disposition. I had at one time two tamed, which I caught with their mother when they were cubs. One was what is called the "Ranger" Bear, that is, it was long-legged and long-bodied, and not so black, and with a little coarser fur than the other variety. The other was what is called a "Hog Bear," and was shorter-legged and blacker. So I am sure the Hog Bear and Ranger are of one species. I have seldom found two alike. I have caught a great many, as many as sixteen in one year, from May 1st to July 1st, around Schoodic and Seboois streams, a few miles east of here. I caught seven the last summer. The larger of the two tamed ones I had was of a milder disposition, and would learn more tricks than the other. Both were females. They had a disposition to pry into everything. One of them got into the pantry once, and upset the flour barrel and went to eating the flour. When she got her mouth so full as to be

clogged, she would clear it out with her paws. She threw the sieve and breadboard out into the kitchen very handily. Another time she got in and took the eggs. They like milk, and honey, and molasses. One of mine would drink milk from a dipper, holding it in her fore-paws. One of my tame ones, if she got loose, would find every hen's nest in the barn and eat the eggs. In the woods they feed on berries and beechnuts and acorns and roots; and they will eat meat of any kind, and will take bear's meat for bait; they will eat fresh fish, corn, and pumpkins, and are fond of oats; in the spring they are fond of the offal left where moose are dressed.

They strike their enemy and try to throw him down, and then bite and tear him. I never saw them hug, and don't believe they do it. They can climb small trees as well as large ones; I have seen where one climbed a cherry tree not more than three inches in diameter. I kept one of my tame ones till she was six years old, and have time and again seen her climb a pole four inches through. She climbed with the ends of all her claws touching the pole; would climb deliberately, and a hundred times a day for gingerbread, apples, etc. She would walk hand over hand along a horizontal pole with her body hanging under it. They climb the tallest of beeches, and break off limbs two inches through, and throw them down, and then come down and eat the nuts. If the limb wont break, they bite it with their teeth, and then pull it toward them and break it. They also gather a part of the top of the tree together, and eat the nuts there.

Bears hibernate, going from three to four months without eating; sometimes during December, January, February, and March, sometimes during January, February,

March, and April. This year there are no beechnuts, and they will probably disappear early. As soon as they begin to eat in the spring, a plug comes away from them, black, shining, and hard, resembling gum, so much so, that some say they eat gum to form it; but it is not so, for the same came from the tame ones in my barn, where they could get no gum. I think it is from the mucous in the intestines. In the barn they covered themselves with straw all over, excepting their ears. Their paws were brought forward around the nose, which was dropped forward and downward. They don't suck their paws. When I spoke to the tame ones in my barn during the winter, they would look up very bright, but would run out their tongue, gape, and drop their heads forward and down between their paws again. I could see the motion of their breathing, and in a cold day could see their breath condensing. I noticed this particularly, because I have heard it said that they did not breathe when hibernating. In the woods they make for winter-quarters a nest of leaves and cedar bark, and I have sometimes seen cedar and fir boughs in their nest. I don't think they get enough of the material to cover themselves as completely as the tame ones did in my barn.

Bears bite fir and spruce trees, and tear down the bark, and when one has bitten a tree, others are apt to do the same, and thus their ranges or lines of travel become spotted as it were. They follow their ranges year after year. The skin of a bear is worth from $3.00 to $12.00.

Gray Squirrel (*Sciurus Carolinensis* Gmelin). Have seen a few Gray Squirrels this year; never saw but one before.

Red Squirrel (*Sciurus Hudsonius* Pallas). The Red Squirrel deposits his winter store in several places. The

bear often finds the half-pint of beechnuts hidden by the Red Squirrel under the leaves and eats them.

STRIPED SQUIRREL (*Tamias striatus* Baird). The striped Squirrel deposits his winter store in a single place.

WOODCHUCK (*Arctomys monax* Gmelin). The Woodchuck lives in holes in the ground; is partial to beans, but lives principally on grass. I think it hibernates.

BEAVER (*Castor Canadensis* Kuhl.). I have caught seventy Beavers. Have killed seven from one house, and left one or more. I killed five from another house, and opened the house, which was about four feet across on the inside, and two feet high. It was oven-shaped. There was but one room to it, and I never saw a house with more. The houses are sometimes round, sometimes oblong. The house is made of brush thrown into a pile, and covered with mud and sticks. The room is eaten out of the brush; that is, the brush is in a pile, and the room is made by gnawing out a part of it. The passage way is a ditch passing downward and forward into the water, and is covered with brush and mud. Right on top of the house is a part of the roof where there is no mud on the sticks, thus leaving the wall open enough there for ventilation.

The Beaver makes his pond to enable him to bring and store his food, which is the bark of white birch, yellow birch, mountain ash, swamp maple, poplar, and willow, and perhaps some others. They throw their brush over their passage way, so that the top of it is in the water; that is, the butt of the bush is over the passage way, and the twigs of the top in the water. They cut down the trees, which are for food, and stick the butts under the brush, leaving the tops to float. If the tree is

larger than one and a half inches, or two inches at farthest, the beaver cuts off the top, and drags it and the stems to his house separately. I have seen the wood as large as five inches, and three or four feet long. Have seen a white birch felled by them four inches in diameter. In the winter they come up under the ice and gnaw their bark there. Gradually in such places air collects under the ice, which is, I think, what they breathe out when they are there. I have seen one stay under water seven and one-half minutes by the watch, and have heard from a reliable man of their staying twelve to fourteen minutes. The Otter will kill young Beavers. I don't know of anything else that destroys them except man. Their meat is excellent, and the meat from their tail is a delicacy.

The Dam.—I will describe one dam. It was lately built. It was six rods long; not straight across the stream, but the middle was further down stream than each end. The groundwork was of small alders, cherry trees, and bushes. Nearer the top, trees from one to one and a half inches in diameter were placed on, the butt being hauled over so as to rest on the bottom of the stream below, and the top woven into the dam. On the upstream side it was covered with moss, mud, gravel, and rocks, and some of the rocks I judge would weigh fifteen to twenty pounds. The water dripped over the dam evenly the whole length. The dam flowed the pond above, which was a mile long. It was not at a narrow place in the brook. It had been built the summer before, and in the fall while I was there, I caught six beavers there, and think I caught them all. There were seven houses in the neighborhood, but only one of them was new. I drove them from this to one of the old ones, and

then to another. This last was a mile from their dam. They began to haul wood to it. I caught none at the new house, but two at the first old house they fled to, and four at the second. I frightened them from the new house by paddling around it in my canoe. It was on an island. They work on their house, putting mud and sticks on it, till freezing weather.

I will describe another dam and settlement of Beavers, on the Restigouche River, in the northern part of New Brunswick. The pond flowed was a mile long. At the foot of the pond was a dam five feet high. Four rods below was a dam three feet high which flowed back to the first dam, raising the water against it one and one-half feet. Three rods farther down the brook was a third dam, not more than two feet high, also flowing back to the dam next above. A rod or two below was a fourth dam, not more than one and a half feet high, which flowed the water back to the third dam. There were two beaver-houses on the pond. The new one, which was the one inhabited, was one-quarter of a mile above the dam. The old one was fifty to sixty rods farther up. I killed seven beavers here that winter (1852 or 1853). I cut the second and third dams down a little at the middle so as to have a running, open stream, and caught four otters there during the winter.

I never saw more than one passage way to a beaver-house, but it was said that there were several to this house. It was, by outside measurement, twenty-one feet across at the base; and we judged it to be ten feet high, but it had the appearance of being two houses joined together. The men who opened it said it had but one room, and nine beavers were in it. I don't think the beaver uses the tail much in swimming, but it makes

much use of it in diving. In trapping, we take care not to drive the beavers away from the pond before it freezes; after it freezes they leave very reluctantly. We bait with swamp maple or mountain ash. We tie the trap to a dry spruce stake, which they will not gnaw.

The beaver weighs from twenty-five to sixty pounds; the latter weight is very large. A good beaver-skin weighs from one to three pounds; price now $2.50 a pound.

I think the beaver gets the oil from the "oilstone" on to his fur by letting it out into the water around, whence it is caught on the fur. I use the "castors" to attract the beavers.

MUSKRAT (*Fiber zibethicus* Cuv.). The muskrat lives in hollows in banks of streams, and also in houses. Eats roots, grass, and clams.

PORCUPINE (*Erethizon dorsatus* F. Cuv.). The porcupine lives in winter on bark. It eats grass; will eat green corn when it can get it; it is very fond of salt; will even gnaw through pork barrels to get the salt. It has been known to get into the cellar and take milk. It is destructive to boots and rigging and tools, where any salt has been left on them.

MOOSE (*Alce Americanus* Jardine). Moose move over but a small district in a winter's day, four or five miles; sometimes in a thaw they move farther. When their tracks are obliterated by the snow, I often track them in this way: I notice the side of the tree from which they have taken the bark. This was the first side of the tree they came to; they then moved on and took the bark from the first side they come to of another tree, and thus left a "blaze" behind them. Sometimes when the old cow lies down, the calf will eat the bark all around the

tree, but this is not the rule. They seem to tear the bark up with the teeth of the lower jaw. Sometimes they may be found in the spring not more than a mile away from where they began in the fall.

They like best the bark of moose wood (the small maple with dark striped bark), mountain ash, and swamp maple. They take the bark of the mountain ash more than of any other tree; but they browse the twigs of the swamp maple most. They will also browse fir and willow and moose bush, and sometimes cut the bark of poplar. They also frequent ponds for the pond lily and the yellow lily.

The largest herd I ever saw had nine in it, but they more often live in herds of four or five. The female brings forth two calves, and they stay with the old cow the summer and winter following. The males more often yard by themselves, but are sometimes found with the female. The sexes come together about the last of September or the first of October, say from September 20th to October 20th.

Moose are not now very plenty about here, but ten years ago they were plenty. I killed two in one August night in Lower Ebeeme pond. They come into the ponds to feed on the lilies. I have seen them in the pond the first of June, with the water half way up their sides, reaching down and taking up the roots of the yellow lily. They come out on very soft bog with no trouble; they drop their body so as partly to swim and partly to wade till they come to shore, then they put their nose on the shore, if it is soft, then raise their forelegs, and then their hind legs one at a time. When swimming undisturbed, I have seen a moose settle down under the water entirely for three or four rods, and then rise and snort

and go down again. Whether he did this to get the flies from his ears, or whether it is his habit, I don't know. A young man who hunted moose with me had seen the same thing, and spoke to me of it. When undisturbed they move, on land, slowly and quietly, but when startled, are all alive. Their principal gait when not walking is a trot, while the deer jumps. In the season for the coming together of the sexes, I have seen the male standing on a log, and heard him grunt at intervals; at other times I have heard them low aloud. Sometimes we call them by imitating the low of the male by sounding through a roll of birch bark. The *males* answer this cry, and come to it; and as they draw near we place the mouth of the trumpet near the water, or, if on land, near the ground, which makes the sound seem farther off, and leads the moose to rush on. When he gets pretty near, it don't do to keep up the deception; then we dip up and pour out water, which brings him right out; or, instead, make a kind of "splash" with the paddle, or any noise that will sound like the stepping of a moose in water. Care should be taken to keep to the leeward of the moose if possible.

A common way of hunting them is to watch in summer nights at places where they come down for lily-pads, and shoot them there. Another way is to hunt them down in winter when there is a crust.

The average weight of a moose's meat after it is dressed is four hundred to five hundred pounds. I have killed one which I think weighed, meat and hides, one thousand pounds. I weighed the meat of one which weighed six hundred and thirty pounds. Moose meat is worth say ten cents a pound, and the skin has been worth from five to twelve dollars since the beginning of the war; I don't know what it is worth now.

Caribou (*Rangifer Caribou* Aud. and Bach.). Caribou are quite plenty a little north of here, about Ragged Lake, Black Brook, etc. Caribou live principally on moss, but eat some twigs. It is faster, I think, than either deer or moose; of these two, the deer is the faster. The meat of a caribou when dressed weighs, I judge, from two hundred and fifty to three hundred pounds.

Deer (*Cervus Virginianus* Boddaert.) Deer are not very plenty about here. They browse "moose-bush," fir, cedar (Arbor vitæ), willow, swamp maple, and lynois bush; in summer they like lily-pads, leaves of trees, and grass. I think that, like the moose, the deer generally bears two young.

[We have introduced the scientific names of the animals mentioned by Mr. Clapp, and would refer those of our readers who wish for information regarding their classification and distribution to the comprehensive and invaluable work of Professor Baird, on the "Mammals of North America," forming the *eighth volume* of the Pacific Railroad Reports, published by order of Congress in 1857. — Editors.]

THE LAND SNAILS OF NEW ENGLAND.

BY EDWARD S. MORSE.

(Concluded from page 609.)

The following species, though minute, are very characteristic, and with the aid of the engravings, but little trouble will be encountered in identifying them. Formerly included under the old genus Pupa, they are now separated under a distinct genus called Leucochila. But slight differences are noticed between the soft parts of the species to be described, and those given previously.

Leucochila contracta *Say* (Fig. 54) is an oval,

conical, whitish shell, having five convex whorls; the spire tapering to a somewhat pointed apex. The aperture is quite large, and is bordered by a widely reflected lip. The aperture is nearly closed with four tooth-like folds, and one is inclined to wonder how it is possible for the animal to protrude and withdraw his body within the shell. The shell has a distinct umbilicus. Length one-tenth of an inch. Animal blackish above; disk light gray. Almost universally distributed throughout the United States east of the Rocky Mountains. It is not a common species in New England. Found in beech groves under bits of rotten bark.

Fig. 54.

LEUCOCHILA ARMIFERA *Say*. (Fig. 55.) This is a much larger species than the preceding one. The shell is cylindrical oblong, of a waxen-white color, having from six to seven smooth convex whorls. Apex rather obtuse; lip reflected, nearly surrounding the aperture. Within the aperture are four or five projecting teeth, the largest being bifid, and starting from the body whorl; in others projecting from the walls of the aperture, and deep seated. Shell slightly umbilicated. Length $\frac{3}{16}$ inch; diameter half the length; animal black. This species appears to be plentiful in many of the Middle and Western States, extending as far east as Vermont, where it has been found on the shores of Lake Champlain.

Fig. 55.

LEUCOCHILA PENTODON *Say*. (Fig. 56.) This species is a third smaller than *L. contracta*, being only $\frac{1}{13}$ of an inch in length. It has about five whorls; is whitish or greenish-white; translucent, though often obscured by dirt that adheres to its surface. Aperture having a thickened ridge within, on which are

Fig. 56.

several minute teeth, the longest one projecting from the body whorl. The number and size of these teeth vary greatly in this species, but the shell is quite characteristic when once determined. It is found in very wet places, under bits of wood by watery ditches. Found in nearly all the States this side of the Rocky Mountains; common in New England.

In the following species the lower tentacles are absent, and the head has lappets on each side, and when viewed beneath seems partially separated from the creeping disk, more like the fresh-water air-breathing snails. As they are best known as Vertigo, we describe them under that head. As the species are very minute, we have given not only magnified figures of the entire shell, but a still more magnified figure of the aperture, as the characters of the species lie mostly in the contour of this portion of the shell.

VERTIGO OVATA *Say* (Figs. 57, 58) has an ovate, dark, amber-colored, and highly polished shell. Within the aperture are seven or eight teeth; these vary greatly in different specimens.

Fig. 57.

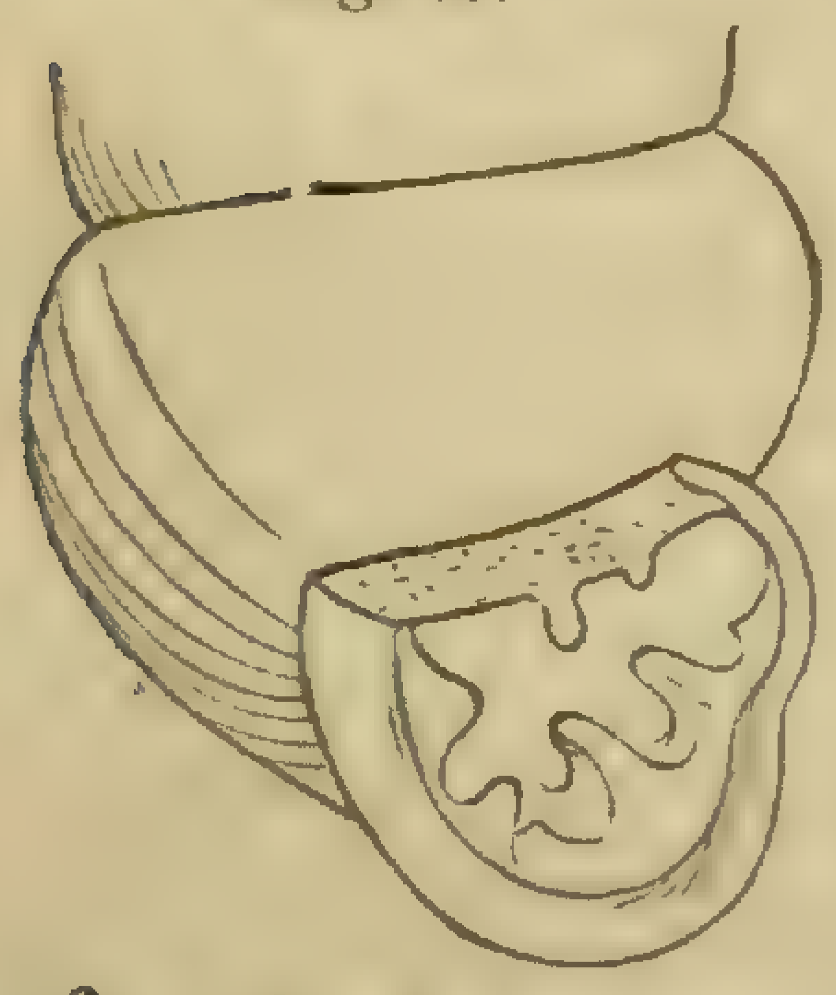


Fig. 58.

This is the largest of New England Vertigos, though measuring only $\frac{3}{40}$ of an inch in length, and $\frac{1}{25}$ of an inch in breadth. It is more globose than the species to follow, and has more teeth within the aperture. This species is almost aquatic in its habits, living under bits of wood and stones, in wet and soggy places. Inhabits all the Western, Middle, and Eastern States. Is common in New England.

Vertigo Gouldii *Binney*. (Figs. 59, 60.) This species is smaller than *V. ovata;* is not so broad compared to its length, and is not polished, but distinctly striated. The teeth within the aperture are five in number, that on the body whorl very large. Length of shell $\frac{1}{66}$ inch, breadth $\frac{1}{32}$ inch. It occurs in woods and groves under leaves. It appears to be common in New England, and has been found in some of the Middle and Western States.

Fig. 59.

Fig. 60.

Vertigo ventricosa *Morse*. (Figs. 61, 62.) In outline the shell resembles that of *V. ovata*, and it has always been confounded with that species. The shell is much smaller, however; has one whorl less, and has only five teeth within the aperture. Length $\frac{7}{100}$ inch. It is not a common species, though I have received it from New York, New Hampshire, Massachusetts, and Maine.

Fig. 61.

Fig. 62.

Vertigo Bollesiana *Morse*. (Figs. 63, 64.) This species has been heretofore confounded with *V. Gouldii.* It has a small shell, lighter colored, polished and translucent. The teeth are five in number, but less prominent. Length $\frac{8}{100}$ inch. Found in hard-wood growths, in company with the smaller snails. It is not a common species.

Fig. 63.

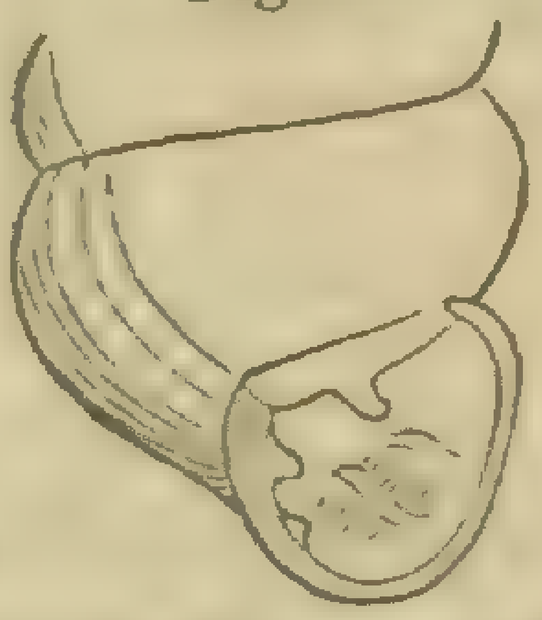


Fig. 64.

Vertigo milium *Gould*. (Figs. 65, 66.) Despite the infinitessimal character of the species described above, this species is much smaller than any of the others, being only $\frac{4}{100}$ inch in length, and weighing but $\frac{5}{1000}$ of a

grain! and this tiny shell encloses a pulsating heart, a lung, stomach, liver, and all the organs we find in the larger snails. The shell has six teeth within the aperture, those on the lower portion of the aperture being long ridges running far within the shell. This species is found under decaying leaves in woods, and sometimes under stones in open pastures. It has a wide distribution in the United States, though it is rarely met with on account of its exceeding minuteness.

Fig. 65.

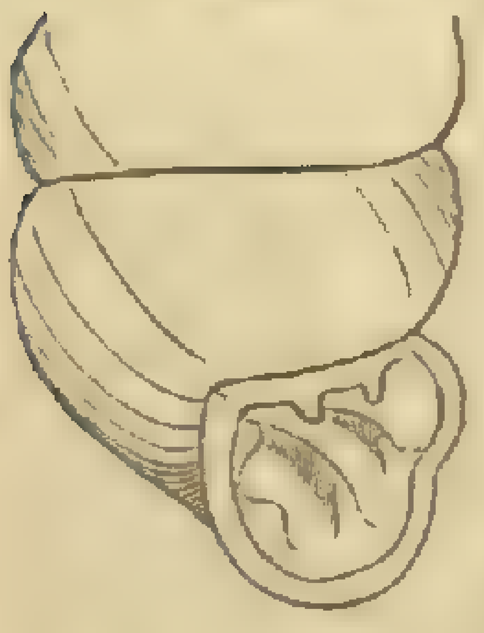


Fig. 66.

VERTIGO SIMPLEX *Gould*. (Figs. 67, 68.) The shell is quite long and cylindrical, having five whorls. The aperture is entirely devoid of teeth, and has a sharp lip. Length $\frac{1}{15}$ of an inch. Found in all the New England States, New York, and some of the Western States.

Fig. 67.

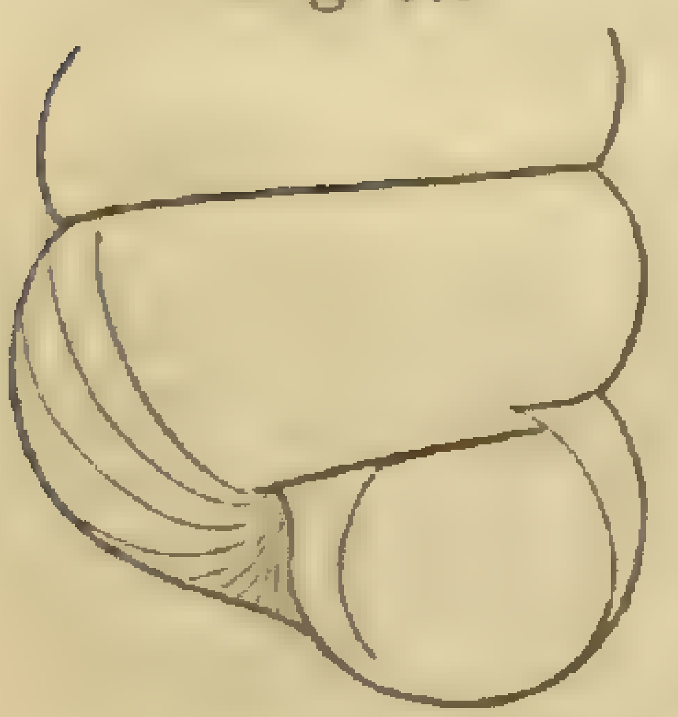


Fig. 68.

VERTIGO DECORA *Gould*. Mr. L. L. Thaxter has found this species at Ascutney, Vermont. We learned this fact too late to prepare a figure of it. We may briefly state that it is something like *V. Gouldii*, though twice the size of that species, and darker colored. It was first discovered in the region of Lake Superior, and one specimen has been identified from Great Slave Lake.

The following group, though air-breathing, are amphibious in their habits. The animal has only two tentacles, with no power to draw them within the head, as in those above described. The eyes, instead of being at the tips of these tentacles, are at the base.

CARYCHIUM EXIGUUM *Say* (Fig. 69) has an elongated

white shell, with five convex whorls, tapering gradually to the apex. Aperture obliquely oval, bordered by a roundish, thickened margin. On the outer margin of the aperture, there is a tooth-like projection, and on the inner margin there is another more prominent. Length of shell $\frac{1}{15}$ inch. Lives in very wet and boggy places in woods. Found in nearly all the States east of the Rocky Mountains.

Fig. 69.

ALEXIA MYOSOTIS *Drapanaud.* (Fig. 70.) Shell ovate, conical, smooth, horn-color. Spire having six or seven whorls, making a short, elevated, pointed spire. Aperture long and narrow, having on the inner margin two or more thin white teeth. Length $\frac{3}{10}$ inch. Found in the crevices of old wharfs and sea-walls, below high-water mark. It is never found away from the salt water, and if it breathes air like the rest of the group, it must take in a supply at low tide.

Fig. 70.

MELAMPUS BIDENTATUS *Say.* (Fig. 71.) Shell ovate, conic, whorls five, the last one three-fourths the length of the shell. Apex short; aperture having two folds or teeth on its inner margin. Color brownish horn. In adult specimens the shell is whitened from erosion. Very young specimens are oftentimes ornamented by dark, revolving bands. Length not quite half an inch. Inhabits the salt-marshes of our coast, where they may be found by thousands just below high-water mark. It is found all along the coast to Florida, though extremely rare north of Massachusetts Bay.

Fig. 71.

With this species we close the description of the Land Snails of New England as continued articles. In a future number of the NATURALIST we hope to give an account of the Slugs or Snails without external shells.

To those who have not the earlier numbers of the NAT-

URALIST, we would say that the terms used in describing the different species are explained and illustrated in the April number, and that a general account of their habits and anatomy may be found in the March number.

REVIEWS.

THE QUARTERLY JOURNAL OF PSYCHOLOGICAL MEDICINE AND MEDICAL JURISPRUDENCE. Edited by *William A. Hammond, M. D.* Vol. I. Nos. 1, 2. July, October, 1867. Quarterly, 8vo. A. Sampson & Co., New York.

Our notice of this journal, which fills an important gap in medical literature, has been long delayed. It will also interest many of our readers, as it bears on those subjects in which all naturalists, especially physiologists, are most interested. The three leading articles are contributed by the Editor. The article On Instinct, its Nature and Seat, gives an excellent summary of the views of various writers on a subject on which much has been written without reaching satisfactory results.

The author's views may be summarized thus: Animals perform three sets of actions; 1st, *reflex*, such as eating, breathing, respiration. "The new-born child does not breathe because of a 'natural blind impulse' to do so, but because the placental connection with its mother, by which its blood was oxygenated, having been severed, and the stimulus of atmospheric air having been applied to its skin, an impression is conveyed to the nervous centres, it is reflected to the respiratory muscles, and breathing takes place." This is a reflex action of the nervous system. It is not instinctive or an act of the reason. 2d, *instinctive*, which are "the result of impressions received from within." "Instinct is that innate faculty which organic beings possess, by which they are enabled or impelled to perform acts without being prompted by the intellectual powers, and even in direct opposition thereto." Dr. Hammond, from whom we have quoted, further states that "instinctive acts are not the result of instruction or experience. This is one of the most prominent points wherein the actions in question differ from those which are the result of intelligence and reason." 3d, *rational*. These are, as the author states, of

"eccentric origin, due to impressions conveyed to the mind through the senses and nerves."

Instinct is strongest in the lower animals, and the new-born of the higher. The young acts first by instinct, until experience and contact with the outer world awakens the dormant reason.

The author thinks that instinct is capable of improvement, that it can be educated through a series of generations, so that "the intelligence of former generations becomes converted into instinct in the descendants." Instances of the aberration of instinct are also common; it is not unerring. All organized beings have instinct. "Plants have instinct; that is, a force co-existent with their growth, and implanted originally in the seed, which impels them to the performance of actions, calculated to preserve their existence, or secure their well being."

We refer the reader to the article itself for facts in illustration of these statements.

NATURAL HISTORY MISCELLANY.

BOTANY.

Botanical Notes and Queries.—Is *Tillandsia usneoides*, the "Black" or "Long Moss" of the Southern States, strictly an epiphyte, or in some sort a parasite? I was once informed by a very intelligent person, that in Florida, where the *Tillandsia* is used by lumbermen as fodder for cattle, the plant always withered and died when the tree that bore it was cut down, showing that it is not merely epiphytic upon the dead surface of the bark. The point is worth investigating. My attention is recalled to this point by a paper on *The Relation of Lichen-growth to the health and value of Trees*, read by Dr. Lindsay before the last meeting of the British Association. Noting that arboriculturists generally regard Lichens as detrimental to the trees they grow on, Dr. Lindsay adduces, in confirmation of that view, the fact that Lichens of the sort, such as *Usnea*, *Ramalina*, etc., contain silica, alumina, lime, potash, phosphates, etc., which could not have been derived from the atmosphere, but must have come from the foster-tree. It does not certainly follow, however, that the Lichen is parasitic, as Dr. Lindsay is disposed to think, for the thallus may as well take up these earthy elements from the dead and decaying bark, and be without connection or contact with any living part of the tree. The general opinion of nurserymen and tree-growers is, that Lichens feed upon the tree, or at least in some way injure it.—A. Gray.

SALSOLA KALI GROWING INLAND.—Every summer, for the last five years, on botanical excursions, I have found at Newburgh (sixteen miles from this place) the *Salsola Kali*, growing quite abundantly on the Erie railroad near that city. All the works on Botany that I have, designate this as a *maritime* plant, and give no other habitat for it. Those specimens which grow most vigorously are found covering the side of an embankment (formed of dry, loose sand) facing the south, and consequently exposed to the scorching rays of the sun all summer. The material in which the plants are rooted is not one from which I should suppose that they could derive any of those saline matters that enter so largely into their composition.—W. R. GERARD.

ROBINIA HISPIDA.—The responses to the query in the November number about this plant are unanimous, and direct to the point, that it is simply and truly indigenous in the pine barrens of the low country, and on barren or rocky hill-tops of the upper country of the Atlantic Southern States. Dr. M. A. Curtis has fruiting specimens collected on the summit of Table Rock, North Carolina (a conclusive station as to nativity), and thinks that it fruits in the lower country as well.—A. GRAY.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.—NATURAL HISTORY SECTION. *Burlington, Vt., August* 21–26, 1867.—"The Insect Fauna of the Summit of Mount Washington, as compared with that of Labrador." By A. S. Packard, jr., M. D. The following notes are thrown together rather to give a summary, from data only approximately correct, of our present knowledge of the distribution of Alpine and Arctic Lepidoptera, than to give anything like a complete account.

The summit of Mount Washington, or that portion lying above the limit of trees, agrees in its climate and other physical features very closely with those of the coast of Northern Labrador, as observed at Hopedale, in latitude 55° 35′.

The seasons correspond very exactly, as the snow melts in the early summer, and ice is formed early in the autumn at about the same dates.

As is well known, the Alpine flora of the White Mountains is identical with that of the arctic regions, which extends far southward along the Atlantic shore of Labrador. Not only is the flora identical so that no species of plant is known to be restricted exclusively to our Alpine summits, but the times of leafing, of flowering, and fruit-

ing of plants is much the same. Such was observed in the *Rubus chamæmorus* and *Arenaria Greenlandica*, for example.

It is also the same apparently with the fauna. The *Chionobas semidea* flies late in July and early in August, in greatest abundance, at the same time that its representative species swarm over the bare rocky hill-tops of the Labrador coast. Their appearance heralds the close of summer, both on the extreme summit of Mount Washington and the exposed hills of Labrador.

Most is known of the Lepidopterous fauna of Alpine and arctic regions, both in America and Europe, and our data will be drawn from this group of insects. In Europe, Thunberg, Zetterstedt, Duponchel, Boisduval, Staudinger, and Wocke, have studied the circumpolar lepidopterous fauna; Möschler and Christoph, Clemens and Scudder and the writer, have described the insects of Labrador, and Messrs. Scudder, Shurtleff, and Sanborn have explored the insect fauna of Mount Washington, and other Alpine summits.

According to Dr. Staudinger, out of sixteen butterflies found in Finmark, two only (*Erebia Manto* and *Argynnis Thore*) occur in the Alps, and also in Siberia. But one butterfly, *Chionobas Aello*, so far as we have been able to learn, is peculiar to the Alps. Of 122 species of lepidoptera inhabiting Labrador, 81 are found only in Labrador, and arctic America, while thirty-one are circumpolar, namely, occur on both sides of the Arctic Ocean, being found in Finmark, Iceland, and the mountains of Norway; six species inhabit the summit of Mount Washington, and four or five of the whole number also inhabit the Swiss Alps. Two of the European Alpine species are found on Mount Washington, New Hampshire.

Certain genera among Insects, as among Mollusca, are almost exclusively arctic. Such are *Chionobas* and *Anarta*, which are paralleled by the two marine genera *Astarte* and *Buccinum*.

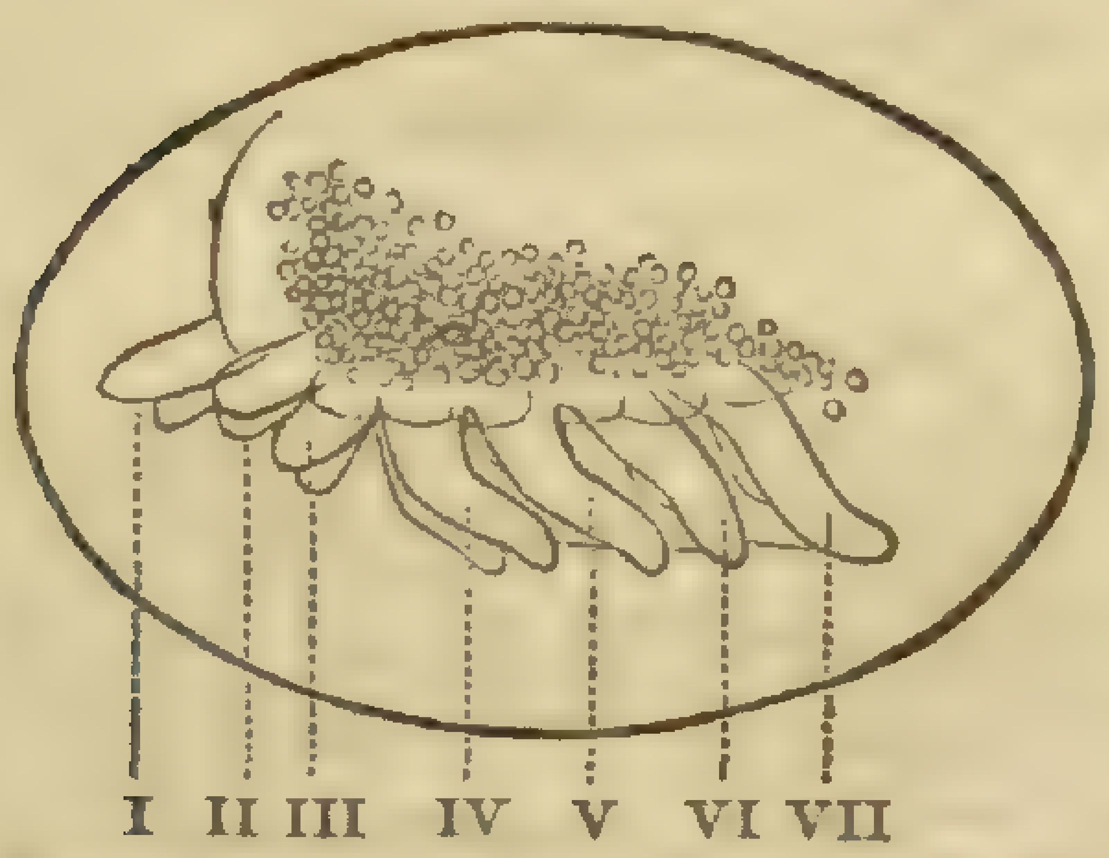
Two species (*Polyommatus Franklinii* and, *Cidaria polata*) abounding in Labrador and the polar regions have not yet been found on Mount Washington. This is paralleled by the occurrence of certain mollusca, e. g. *Leda truncata*, in the high arctic seas, which have become extinct in the seas southward, where they are now found fossil: so that the distribution of the arctic insect fauna seems to be paralleled by that of arctic marine invertebrates. As in the temperate seas certain abysses and banks swept by the arctic currents are peopled by outliers of an Arctic marine fauna, so the Alpine elevations or atmospherical abysses, rising out of a temperate into an Arctic climate, seem peopled by outliers of an arctic land fauna. These outliers are relics of an arctic fauna, that during the early part of the Quaternary period, *i. e.* the Glacial Epoch, peopled the surface of the temperate zone.

We cannot suppose a special creation of organized beings for the Alpine summits. *Chionobas semidea,* thus far only known to inhabit the summit of Mount Washington, may still be found northward; or, if not, probably became extinct north, finally localizing itself on the single peak where it now occurs.

"On the Development of a Dragon-fly, *Diplax.*" By A. S. Packard, jr., M. D. 1. In all the eggs observed, the blastoderm had been formed, and consequently the blastodermic cells had disappeared, and, at this stage, there was a clear space about what is probably the anterior pole of the egg, where the head is eventually to be developed.

2. In the next stage (Fig. 1) the head is partially sketched out, with the rudiments of the limbs and mouth-parts; and the sternites or ventral walls of the thorax and of the two basal rings of the head appear. The anterior part of the head, the so-called "procephalic lobe" overhangs and conceals the base of the antennæ.

Fig. 1.

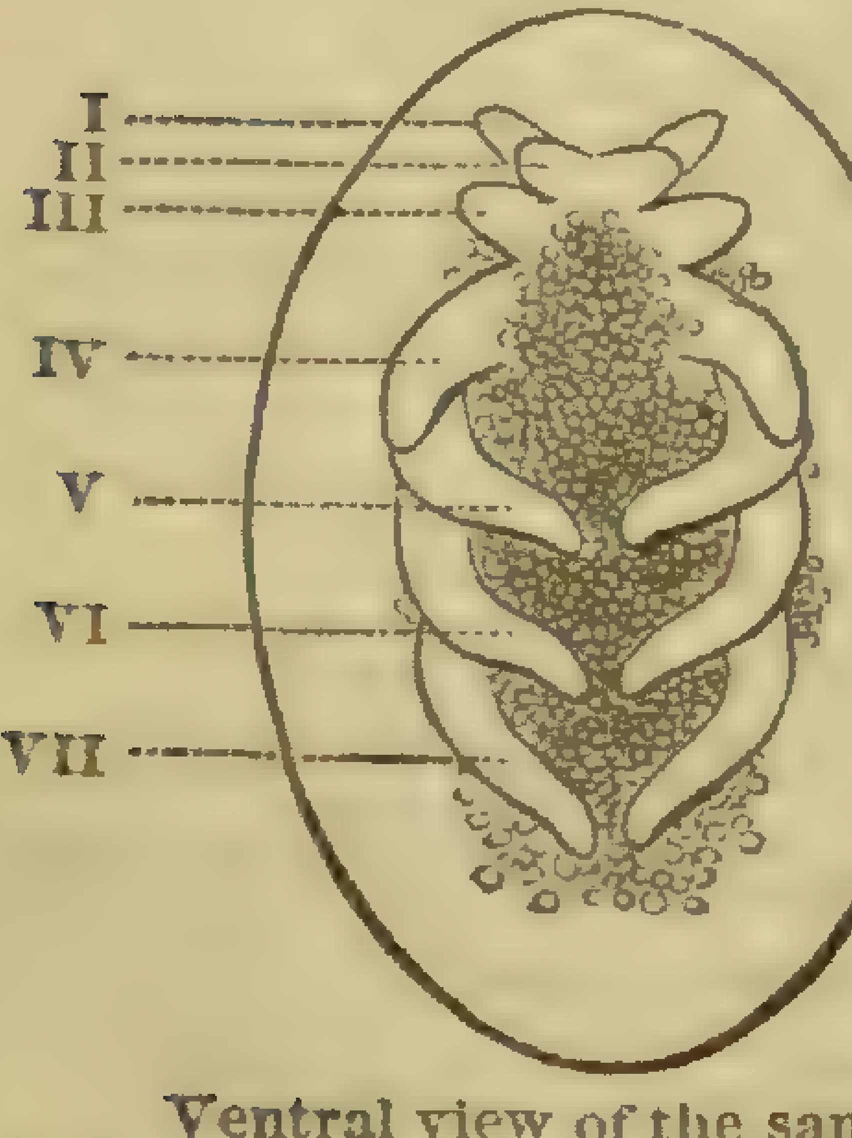


Side-view of embryo. The procephalic lobe is not shown. I, antennæ; II, mandibles; III, maxillæ; IV, second maxillæ [labium]; V-VII, legs. These numbers and letters are the same in all the figures. The under-side [sternum] of six segments are indicated.

The antennæ, mandibles, and maxillæ form a group by themselves, while the second maxillæ (or labium) are very much larger and turned backwards, being temporarily grouped with the legs.

There are traces only of the two basal sterna of the abdomen. This indicates that the abdominal segments grow in succession from the base of the abdomen, those at the extremity appearing last.

Fig. 1, *a.*



Ventral view of the same.

The development of the hinder or post-oral rings of the head, together with the antennal segment, *i. e.* the first one in front of the mouth, at this time accords with that of those of the thorax, so that the process of development of the two regions and their appendages are identical throughout.

3. In the next stage (not figured) the yolk is completely walled in, though no traces of segments appear on the dorsal and pleural areas. The yolk granules fill the entire cavity of the body extending into the appendages. The head has enlarged, the remaining abdominal urites appear, and the abdominal lobe or post-abdomen

is indicated, being curved under the body, and touching the middle of the abdomen.

The rudiments of the eyes appear as a darker rounded mass of cells indistinctly seen through the yolk-granules, and situated at the base of the antennæ. The three anterior appendages, when seen sideways, are equal in size and length, the antenna being very contiguous to each other.

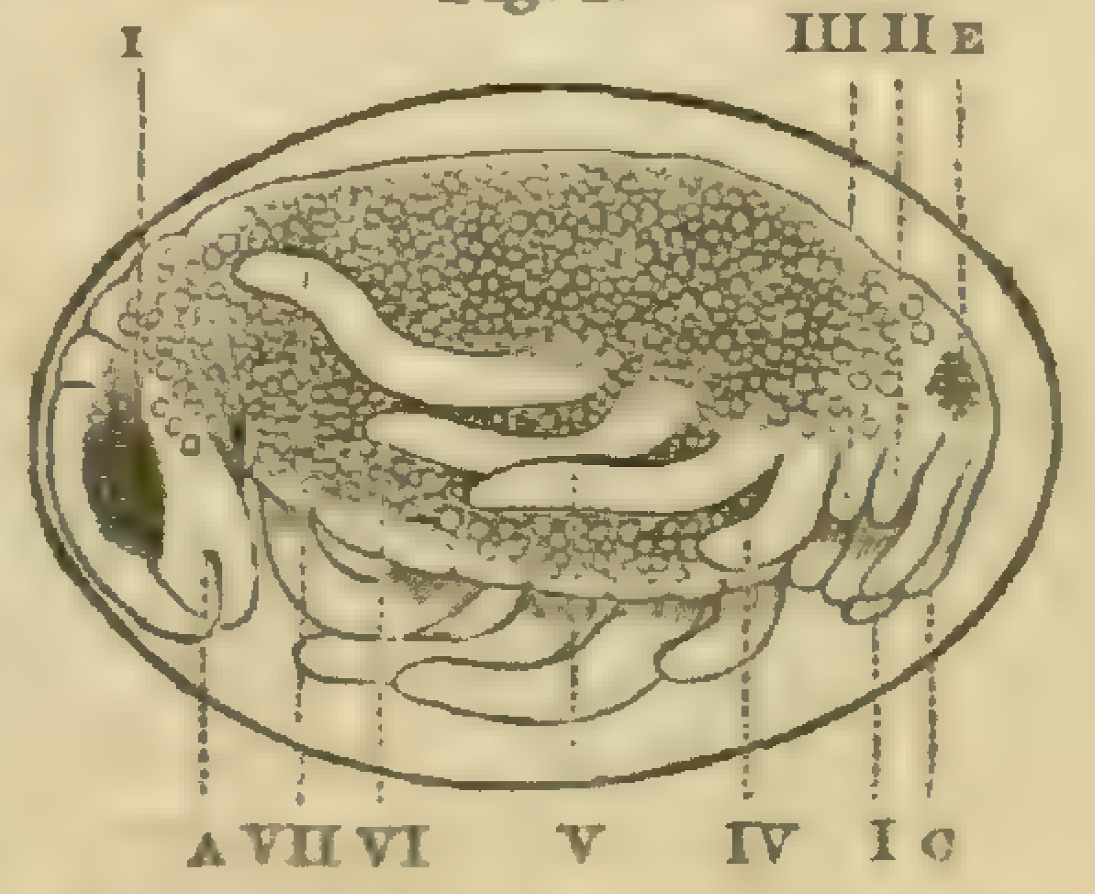
The second maxillæ are a little over twice the length of the first maxillæ and are grouped with the legs, being curved backwards. They are, however, now one-third shorter than the anterior legs. The second maxillary sternum is still visible.

The legs are now unequal in size, the two anterior pair being of the same length, though the middle pair are slightly thicker than the first pair; while the third, or posterior pair, are a third longer, and drawn back upon the side of the body, the ends nearly reaching the end of the egg.

The tip of the abdomen (or post-abdomen) consists of four segments, the terminal one being much the larger, and obscurely divided into two obtuse lobes.

The abdominal sterna (urites) are now well marked, and the nervous cord is represented by eight or nine large oblong-square (seen side-ways) ganglia, which lie contiguous to each other.

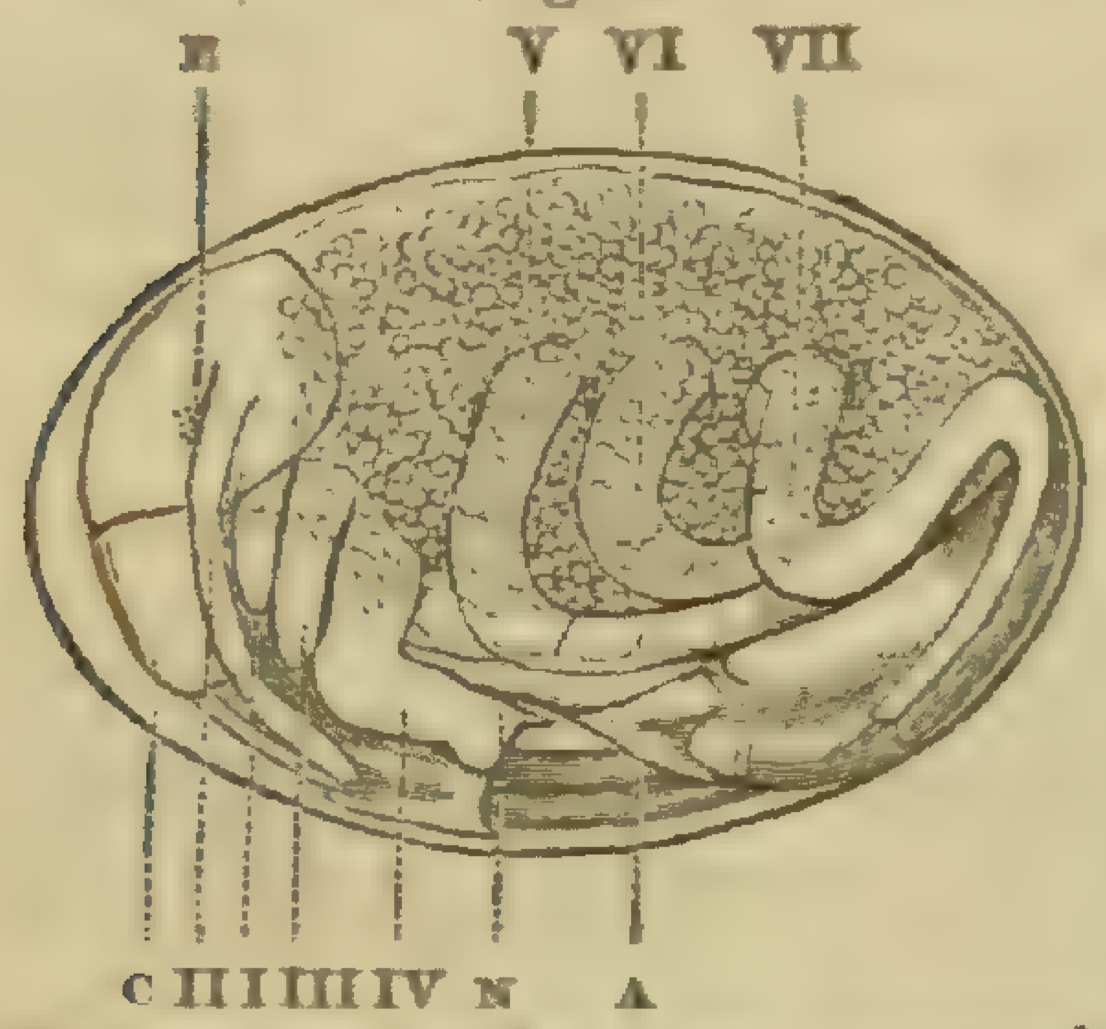
Fig. 2.



An embryo much farther advanced. C, clypeus, forming a part of the "procephalic lobe;" E, eye; A, bilobed extremity of the abdomen; I, the rudiments of the intestine.

The formation of the eyes, the post-abdomen, the sterna, and median portion of the nervous cord seem nearly synchronous with the closing up of the dorsal walls of the body over the yolk-mass.

Fig. 3.



The embryo still farther advanced. N, nerve knots or ganglia

4. The succeeding stage (Fig. 2, compare Zaddach's fig. 40) is signalized by the appearance of the rudiments of the intestine, while the second maxillæ are directed more forward.

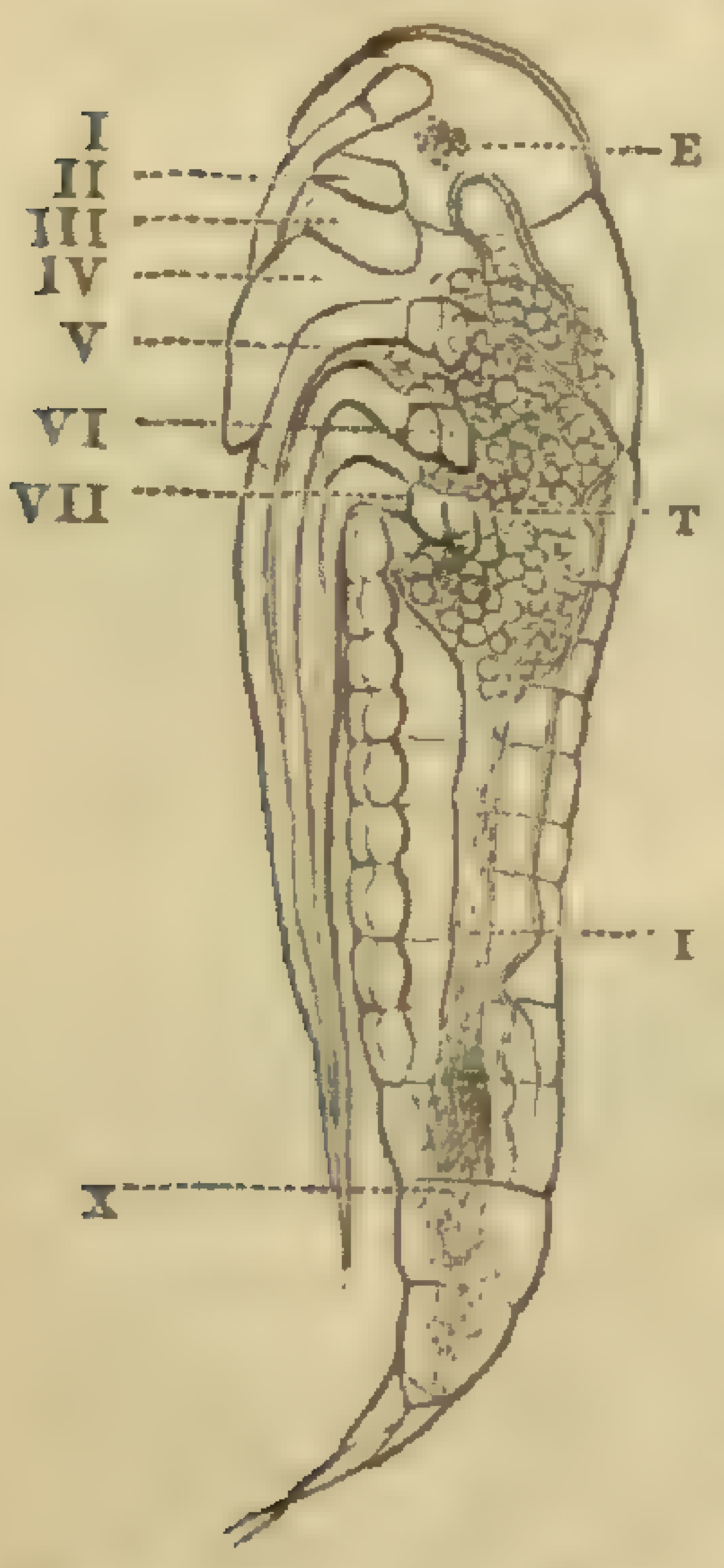
5. This stage (Fig. 3), is characterized by the differentiation of the head into the ophthalmic ring, or eye-bearing piece, and the supraclypeal piece, and clypeus, together with the approximation of the second pair of maxillæ, which, when united, form the labium, the extremities of which are now situated in the middle of the body.

The antennæ now extend to the middle of the labium, just passing beyond the extremities of the mandibles and maxillæ. The suture separating the eye-bearing piece from the antennary, mandibular, and maxillary pleurites and supra-clypeus, is distinct, the clypeus is now very distinct, and as large, seen laterally, as the supra-clypeus, though differing from it essentially in form.

The abdomen is now pointed at the extremity and divided into the rudiments of the two anal stylets, which form large acute tubercles. The yolk mass is now almost entirely enclosed within the body walls, forming an oval mass.

6. At this stage, the embryo is quite fully formed, and is about ready to leave the egg. The three regions of the body are now distinct. The articulations of the tergum are present, the yolk mass being completely enclosed by the dorsal walls. The ventral ganglia are fully formed and are seen laterally to be square, with the square ends opposed, though the commissures cannot be distinguished. More careful observation will undoubtedly reveal their presence. The body is so bent upon itself that the extremities of the second maxillæ just overlap the tip of the abdomen.

Fig. 4.



The embryo taken from the egg, but nearly ready to hatch. T, the dotted line crosses the main trachea, going through the yolk mass, now restricted to the thoracic region. At x, the tracheæ send off numerous branches around an enlargement of the intestine, where the blood is aerated; better seen in Fig. 5. The abdomen should be represented as consisting of eleven segments, the last being a minute triangular piece.

The front of the head is now still farther differentiated. The supra-clypeal piece seems to be merged in with the opthalmic ring, the sutures between them having disappeared. The insertion of the antennæ are removed higher up to just in front of the eyes, or rather the eyes have dropped down, as it were. The clypeus is broad and large, and the bilobate labrum is separated from it by a suture. The mandibles and maxillæ are still tubercular in shape, the teeth of the former not yet appearing. The two limbs of the labium are now placed side by side, with the prominent spinous appendage on the outer edges of the tip. These spines are the rudiments of the labial palpi.

The legs are long and bent partially back on themselves; at the angles partially articulated. The femoro-coxal joints are very distinct, the tarsi are directed upwards and the two claws are simple, straight, and equal in size. The tip of the abdomen ends in two unequal pairs of stylets, terminating in a long bristle. 6 a (Fig. 4.) The general form of the embryo at a still later period on being taken from the

egg and straightened out, reminds us strikingly of the Thysanura, and shows quite conclusively that the Poduræ and Lepismæ, and allied genera, are embryonic forms of Neuroptera, and should therefore be considered a family of that suborder. Seen laterally, the body gradually tapers from the large head to the pointed extremity. The body is flattened from above downwards. At this stage the appendages are still closely appressed to the body.

7. This period occurs after the exclusion of the embryo, but the limbs are still laid along the body. They, however, with the mouth-parts, stand out freer from the body. The labium, especially, assumes a position at nearly right-angles to the body. The antennæ, mandibles, and maxillæ are now free, and have taken on a more definite form, being like that of the young larva, and stand out free from the body. The head is much smaller in proportion to the rest of the body, and bent more upon the breast.

Fig. 6.

The *pupa* of Diplax, in which the eyes are much larger, and the legs much shorter than in the recently hatched larva.

Fig. 5.

The *larva* just hatched and swimming in the water. N, ventral cord or nervous ganglia; D, dorsal vessel, or "heart," divided into its chambers. The anal valves at the end of the abdomen, which open and shut during respiration, are represented as being open. Both of the dotted lines cross one of the tracheæ. X, net-work of tracheæ.

8. *The Larva* (Fig. 5). The head is now free, and the antennæ stand out free from the front. The thorax has greatly diminished in size, while the abdomen has become wider, and the limbs very long; and the numerous minute tubercles seen in the preceding stage have given origin to hairs. The dorsal vessel can now, for the first time,

be seen. The resemblance when in motion to a spider is most striking. Fig. 6 represents the pupa of Diplax.

ESSEX INSTITUTE, March 4, 1867. — Mr. E. S. Morse spoke of the Cephalopods, and alluded to the many fallacious stories regarding the Cuttle-fish, citing Victor Hugo's description of the Devil-fish, in which the characters of two entirely different animals were mixed.

Vice-president Goodell called the attention of the meeting to the recent donation of one hundred and forty thousand dollars, by Mr. PEABODY, for the *Promotion of Science and Useful Knowledge in the County of Essex*, and read the letter and instrument of trust from Mr. Peabody, and the reply of the Trustees.

F. W. Putnam, Superintendent of the Museum, introduced the following Resolution: —

Resolved, — That the Institute has learned with feelings of gratitude and pleasure the fact of the munificent donation of $140,000 by George Peabody, Esq., for "the promotion, among the inhabitants of the County of Essex, of the study and knowledge of the Natural and Physical Sciences, and of their application to the Useful Arts;" and while, as citizens of this county, the members of the Institute are justly proud that this donation comes from a native of the county, they are most deeply sensible of the honor conferred upon their body by its being selected as the Institution with which the Trustees of this fund are to co-operate in securing the objects of the donor.

Dr. George B. Loring seconded the Resolution with appropriate remarks, and it was unanimously adopted.

A committee of seven members of the Institute was appointed to confer with the Trustees of the Peabody Fund in regard to the co-operation of the Institute.

MAY 8. *Annual Meeting.*— Reports of the officers were read; seventy-seven resident, and sixteen corresponding members have been elected during the year, and notices of the death of five resident, and four corresponding members have been received. Five field meetings, one social meeting, and the regular evening meetings, have been held during the year. A course of five lectures on zoölogy, by Mr. Morse, has been given by the Institute. The delay that has occurred in the publication of the Proceedings and Historical Collections, it is hoped, will not occur again, now that the Institute has established a printing office. It is believed that the establishment of Mr. Bicknell as a preparator of microscopical slides and similar work will prove instrumental in the promotion of some of the objects of the Institute. The total expenditure during the year was $2,491.41, receipts $2,521.33. Four thousand and eighty-six volumes, and parts of volumes, pamphlets, etc., were received during the year, from two hundred and nine contributors. Thirteen thousand specimens have been added to the Natural History Department, by two hundred and eighty-eight donations; and sixty-six donations have been made to the Historical Department. Over four hundred zoölogical specimens have been presented to other societies, and to individuals during the year.

GLOSSARY.

Abdomen. Applied in insects and crustacea to the third or last region (hind-body) of the body.
Acalephs (Greek *acalephe*, stinging). A class of Radiated Animals, so called from their power of stinging and benumbing their prey.
Acanthometra. A genus of Rhizopods.
Acarus. The Mite (Cheese-mite, Itch-mite, etc.), a low degraded form of spider.
Acer. The Maple.
Acetification. The act of acetifying; the operation of making vinegar.
Acnanthus. A genus of Diatoms.
Actinocrinus (Gr. *actin*, a ray, and *crinos*, a lily). A genus of Crinoids.
Æschna. A genus of Dragon-flies.
Agaricocrinus. (From *Agaricus*, a mushroom, and *crinos*). The Mushroom-like Crinoid.
Agnostus. A genus of Trilobites.
Agrion (Gr. *agrios*, rural). A genus of small slender Dragon-flies.
Alga (pl. Algæ). The Sea-weeds; an order of cryptogamous plants, mostly inhabiting the ocean.
*Allosorus.** The Rock-brake; a species of fern.
Alsine. The Grove Sandworts; a genus of the Pink family.
Amarantus. The Amaranth.
Amorphous. Shapeless; without any definite form.
Amphiprora. A genus of Diatoms.
Amphitetras. A genus of Diatoms.
Ampulex. A genus of Sphegidæ or Sand Wasps.
Ampullaria (L. *ampulla*, bottle, jug). A genus of land shells.
Andromeda. Mythological name. A genus of the Heath family.
Androspores. The term applied to the zoöspore of algæ, which is developed into the dwarf male plant.
Antenna (L. a sail-yard). The first pair of feelers; the *palpi* being the second.
Anthomyia (Gr. *anthos*, flower, and *muzo*, to suck). A genus of flies (Diptera) frequenting flowers in the perfect state.
Anthophorabia (*Anthophora*, a wild bee, and *bio*, to live). A parasite of Anthophora, etc.
Anthrax (Gr. *anthrax*, coal). A genus of Diptera.
Anthropoid. Man-like; applied to the higher apes.
Aphis (Gr. *aphuo*, to drink in, to exhaust). A genus of Plant Lice.
Arachnids (Gr. *arachne*, a spider). The order of Spiders, Scorpions, Mites, etc.
Arachnodiscus (Gr. *arachne*, spider, *discos*, disk). A genus of Diatoms.
Archæology. The science of primitive or prehistoric man, describing the remains of the early races of men.
Arctia (Gr. *arctos*, a bear). A genus of moths, with very hairy larvæ, called "yellow bears."
Arenaria. The Sandwort; one of the Pink family.
Argynnis. A mythological name. A genus of butterflies.
Ascalaphus. A genus of Dragon-fly-like Hemerobiidæ, a neuropterous family.
Asclepias. The Silk-weed, Milk-weed, a genus of the Silk-weed family.
Aspidium. The Shield-fern, Wood-fern.
Asterionella (Diminutive of Aster, a little star). A genus of Diatoms.
Asteromphalus (Gr. *aster*, star, and *omphalos*, navel). A genus of Diatoms.
Astrophytidæ. A family of Ophiurans, containing the genus Astrophyton, the Medusa's head sand-star.
Aurelia. A genus of Jelly-fish.
Aurochs. The *Bison priscus*, the Lithuanian bull.
Axil. The angle formed by the stalk of a leaf with a stem, or by a branch with the stem.

Bacillaria. A genus of Diatoms.
Bacillariæ (L. *bacillum*, a rod or wand). A name originally applied to the Desmids and Diatoms collectively.
Balsaminaceæ. The botanical family of balsams.
Benzöin. A resinous substance exuding from the Styrax benzoe, or benzoin, a tree of Sumatra.
Betulaceæ. The botanical family of Birches.
Biatora. A genus of Lichens.
Biddulphia. A genus of Diatoms.
Biology. The Science of Life, embracing the habits and instincts, and development of organized beings.
Blastoderm. The primitive skin of the embryo.

* The derivations of botanical names are fully given in Gray's Manual of Botany.

Blastodermic cells. The cells forming the blastoderm.
Bolina. From the Latin, meaning a little ball. A genus of Acalephs.
Bombycic acid. An acid secreted by the Silk-worm, *Bombyx*, and allied genera.
Bombycidæ. From Bombyx; a family of moths.
Botaurus (Gr. *bos*, bull, *taurus*, bull). A genus of Herons.
Botrychium. A genus of Ferns.
Bottosaurus. A genus of fossil Crocodiles from the Cretaceous formation.
Bouquetin. The Wild Goat.
Brachiopoda (Gr. *brachion*, arm, and *pous*, foot). An order of Mollusca, so called from the arm-like fringe surrounding the mouth.
Brachiospongia (Gr. *brachion*, arm, spongia). A genus of fossil sponges.
Bulbochæta (L. *bulbus*, bulb, and *chaite*, a bristle). A genus of fresh-water algæ.

Cabombaceæ. The Water-shell family of plants.
Cacalia. The Indian Plantain.
Caffeine. A bitter substance in coffee.
Calcareous. Consisting of chalk or lime.
Callitriche. The Water-star wort, a genus of the river-weed family.
Calluna. A genus of the Heath family.
Calopteryx (Gr. *kalos*, beautiful, *pteron*, wing). A genus of Dragon-flies.
Calypso. Mythological name (botany).
Cambrian. A term applied in Great Britain to the lowermost strata of Silurian rocks.
Campanula (Italian *Campana*, a bell). The Bell-flower.
Campylodiscus (Gr. *campulos*, flexible, *diskos*, disk). A genus of Diatoms.
Capsule. A pod; any seed-vessel which splits open when dry.
Carboniferous. Belonging to the coal formation.
Carcharodon (Gr. *karcharos*, rough, *odon*, tooth). A genus of sharks.
Carex, pl. *carices.* A sedge. A genus of the Sedge family.
Centaurea. The Star-thistle; one of the composite family.
Centurus. A genus of Woodpeckers.
Cephalopoda (Gr. *kephale*, head, *pous*, foot). The Cuttle-fishes, Squids, etc. A class of Mollusca.
Cephalothorax. The head-thorax or anterior region of the body of the Crabs; also usually applied to the similar part in spiders.
Ceratites (Gr. *ceras*, a horn). A fossil cephalopod.
Cerebral. Relating to the brain.
Cerebellum. One of the divisions of the brain, situated at the base of the skull.
Ceresa. A genus of hemipterous insects.
Cermatia (Gr. *kerma*, composed of segments). A genus of Myriapods.
Cestoids (Cestoidea, Gr. *kestos*, a band, *eidos*, form). A group of parasitic worms.
Chalcid. Relating to the hymenopterous family Chalcididæ.
Chelonian. Relating to the Chelonians, or turtles.
Chenopodium. Goose-foot, Pig-weed; a genus of the Goose-foot family.
Chionobas (Gr. *chion*, snow, *bio*, to live). A genus of arctic butterflies.
Chloeön. A genus of the neuropterous family, Ephemeridæ.
Chrysalis. The pupa, or second stage in the transformation of insects.
Chrysopa (Gr. *chrusopes*, golden). The Golden-eyed, lace-winged fly. A genus of the Neuropterous family Hemerobiidæ.
Chrysophanus (Gr. *chrusos*, golden, and *phaneo*, to appear). A genus of butterflies.
Cicindela. The Tiger-beetle. A genus of the Coleopterous family Cicindelidæ.
Cimex. The Bed-bug. A genus of the Hemipterous family, Cimicidæ.
Circes, pl. of *Cercis.* The Judas-tree; Red-bud. A genus of the Pulse family.
Cladoniæ, pl. of *Cladonia.* The Reindeer moss.
Closterium. A genus of Desmids.
Clypeus. The piece lying in front of the eyes, and next the labrum.
Coagulum. A clot.
Cocconema. A genus of Diatoms.
Cœanothus. The New Jersey tea; Redwood. A genus of the Buckthorn family.
Cœlabogyne. A genus of the Spurge family.
Coleoptera (Gr. *koleos*, sheath, *pteron*, wing). The Beetles. So called from the upper wings being thickened, and covering or ensheathing the under membranous pair.
Colymbitæ. The family of Divers and Loons.
Comandra. The bastard Toad-flax. A genus of the Sandal-wood family.
Comatula (L. *comatus*). A genus of living Crinoids.
Condyle. The knuckle; a protuberance in a bone at its extremity.
Conferval, confervoid. Relating to Confervæ; a group of algæ, or sea-weeds.
Conifers. The Pines, or cone-bearing plants.
Conocephalites (Gr. *conos*, cone, *cephale*, head). A genus of Trilobites.
Conularia (L. *conulus*, a little cone). A genus of Pteropod shells.
Conulus (L. diminutive of *conus*, a cone). A genus of Land-snails.
Coracöid. A process of the blade-bone, shaped like a crow's beak.
Corolla. The leaves of the flower within the calyx.
Corrugated. Wrinkled.
Coryne. A genus of Acalephs.
Coscinodiscus (Gr. *koskinon*, a sieve, *diskos*, disk). A genus of Diatoms.
Corydalus. (Gr. *korydalos*, Alauda cris-

tata). A genus of the Hemerobius family of Neuroptera.

Cotyledon. Seed-leaf. The seminal leaf of a plant.

Crabronidæ. The Hymenopterous family of Sand and Wood-wasps.

Craspedodiscus (Gr. *kraspedon*, edge, limb, *discos*, disk). A genus of Diatoms.

Cretaceous. The name of the chalk formation or geological period.

Crinoidal. Relating to Crinoidea (Gr. *krinos*).

Crustacea. The class of articulata comprising the crab, lobster, beach-flea, etc.

Cryptogamia (from the Greek, meaning "hidden fructification"). Flowerless plants, not bearing real blossoms or true seeds (*i.e.*, with an embryo ready-formed within.

Cryptogamous. Relating to the *Cryptogamia*.

Culm. A straw. The stem of grasses and sedges.

Cupuliferæ. The Oak-family.

Cuscuta. The Dodder. A genus of the Convolvulus family.

Cyathocrinus (Gr. *cuathos*, cup, *krinos*, lily). A genus of Crinoidea.

Cyathophylloid, like *Cyathophyllus*. A genus of fossil corals, shaped like a *cyathus*, or cup.

Cycads (*cycas*). A genus of trees intermediate between the palm and the ferns.

Cyclosis. The circulation in closed cells of plants.

Cyclotella (Gr. diminutive of *kuklos*). A genus of Diatoms.

Cynocephalus. The dog-faced Baboon; one of the anthropoid apes.

Cynomys (Gr. *kunon*, dog, *mus*, mouse). A genus of squirrels.

Cynthia. Mythological name. A genus of butterflies.

Cyperaceæ. The Sedge family.

Cypridina. A genus of Entomostraca: a group of small Crustacea, called water-fleas, etc.

Cystidians (Gr. *kustis*, sac, bladder, *idios*, like). A group of fossil Echinoderms.

Deciduous. Falling off; said of leaves which fall in autumn.

Delphax. A genus of the Hemipterous family Cercopidæ.

Dendritic. Tree-like in form.

Devonian. One of the older geological formations; the Old-Red Sandstone.

Dextrine. The gummy matter into which the interior substance of starch globules is converted by certain acids, etc.

Diatomaceæ (Gr. *dia-temno*, to cut in two). The group of silicious-shelled algæ.

Dichogamy. See p. 404.

Dichotomous. Two-forked.

Didelphys (Gr. *dis*, double, *delphus*, uterus). The Opossum. A genus of marsupials.

Dimorphism. When a part, or an animal itself takes on two forms; or a mineral crystallizes in two forms.

Dinicthys. A genus of gigantic extinct fish.

Diœcious or *Dioicous*. When the stamens and pistils are in separate flowers, on different plants.

Diplax (Gr. *dis*, two, *plax*, surface). A genus of Dragon-flies.

Diplolepis (Gr. *diploös*, double, *lepis*, scale). A genus of Hymenopterous Gall-flies.

Diptera (Gr. *dis*, two, *pteron*, wing). The two-winged insects, like the Musquito and House-fly.

Discoid. Like a disc.

Dycotyledonous. Having a pair of cotyledons.

Echinoderms (Gr. *Echinus*, sea-hedgehog, *derma*, skin). A class of Radiata.

Elephas. The genus of Elephants.

Embryology. The science relating to the development of animals.

Empetrum. The Black Crowberry.

Empidonax. The Fly-catcher; a genus of birds.

Encrinites. The stalks of Crinoidea.

Encyonema (Gr. *egkuos*, gravid, swelling, *nema*, thread). A genus of Diatoms.

Entomostraca (Gr. *Entomon*, insect, *ostracon*, shell). An order of Crustacea, containing the Water-fleas, etc.

Entozoön, *Entozoa* (Gr. *entos*, within, *zoön*, animal). A group of internal parasitic worms.

Eocene (Gr. *eos*, morning, *kainos*, recent). The first of the three subdivisions of the tertiary epoch.

Eozoön (*Eos*, early, *zoön*, animal). The first created animal yet known. A genus of Foraminifera.

Ephyra. The young of Jelly-fishes, such as Aurelia.

Epidermis. The skin.

Ephemera. The May-fly; a neuropterous genus.

Ephemeridæ. The neuropterous family, represented by the genus Ephemera.

Epimerum. The side-piece of a thoracic ring, and situated behind the episternum of insects.

Episternum (*Epi*, upon, *sternum*, breast-piece). A piece in a thoracic ring lying next to the sternum, and usually in front of the epimerum.

Epiphysis. Any portion of a bone separated from the body of a bone by a cartilage, which becomes converted into bone by age.

Erigeron. The Flea-bane; a composite flower.

Euastrum (Gr. *Eu*, beautiful, *aster*, star). A genus of Desmids.

Eucope. A small Jelly-fish.

Eumenes (Gr. *Eumenes*, benevolent). A genus of Wasps.

Eunotia (*Eu*, beautiful, *notos*, back). A genus of Diatoms.
Eupodiscus. A genus of Diatoms.
Euphorbia. The Spurge Plant.
Eurylepis (Gr. *euros*, broad, *lepis*, scale). A genus of Fishes.
Euryteridæ (Gr. *euros*, broad, *pteron*, wing). The family of which Euryteris is the type.
Euscelosaurus. A genus of fossil reptiles.

Fascicle. A close cluster.
Fauna. An assemblage of animals peopling a certain country. We also speak of the Bird-fauna, or Insect-fauna of a country.
Favositidæ. The family of corals represented by the genus Favosites.
Femur. The thigh bone.
Ferrous. Relating to iron.
Fibrine. Belonging to the fibres of plants.
Fibula. The long bone by the side of the tibia.
Filamentous. Like a hair or filament.
Flabellaria. From *flabellum*, a little fan.
Flora. An assemblage of plants belonging to a certain country. We also speak of a Phanerogamous or Cryptogamous flora.
Fœtus. The young of any animal in the womb.
Foraminifera. The shell-making Rhizopods.
Forbesiocrinus (Forbes, *krinos*, lily). A genus of Crinoids, named in honor of Edward Forbes.
Fumaroles. A hole in a volcano from which smoke issues.
Fusiform. Spindle-shaped.

Ganoid. Relating to the ganoid fishes, distinguished by angular scales.
Gavials. A genus of Crocodiles.
Gemmiparous. Growing by buds, as in polyps.
Gentianaceæ. The Gentian family.
Geraniaceæ. The Geranium family.
Gerris. The Water-skater; a homopterous genus.
Gibbous. Swollen.
Globigerina. A genus of Foraminifera; the shells consisting of numerous globular chambers.
Gomphonema (Gr. *gomphas*, wedge, *nema*, a thread). A genus of Diatoms.
Grammatophora (Gr. *gramma*, writing, *phoreo*, to bear). A genus of Diatoms.
Grapta (Gr. *grapho*, to write). A genus of Butterflies.
Grallatorial. Relating to the Grallatores, or Wading-birds.
Graphitic. Relating to Graphite, plumbago.
Gregarina. A microscopic genus of Entozoa.
Grossulariaceæ. The Currant family.
Gymnadenia. The Naked-gland Orchis.
Gynandrosporous. See p. 526.
Gypona. A genus of the Hemipterous family Cercopidæ.

Habenaria. A genus of Orchids.
Halesidota, Halysidota (Gr. *halusidotos*, chain). A genus of the Lepidopterous family Bombycidæ.
Haliotidæ (Gr. *halios*, marine, *ous*, ear, sea-ear). The Molluscan family, so named from the genus Haliotis.
Helenium. The false Sunflower. A genus of composite flowers.
Heliolites (Gr. *helios*, sun). A genus of fossil corals.
Helminthosporium (Gr. *helmins*, worm, *spora*, seed). A genus of Fungi.
Hematite. A variety of native oxide of iron.
Hemeristia (Gr. *hemera*, day). A genus of fossil neuroptera, allied to Corydalus.
Hemerobina (Hemerobiidæ). A neuropterous family named from the typical genus Hemerobius.
Hemiptera (Gr. *hemi*, half, *pteron*, wing). The sub-order of bugs, including the Cicada, etc.
Hippurites (Gr. *hippos*, horse, *oura*, tail). A genus of fossil shells.
Hirundo. The Swallow.
Holothurians (Gr. *holothouria*). An order of Echinoderms.
Homoptera (*homos*, similar, *pteron*, wing). A subdivision of the Hemiptera.
Honkenya. The Sea-sandwort. A genus of the Pink family.
Humerus. The thigh-bone.
Hyaline. Transparent.
Hyalodiscus (Gr. *hualos*, hyaline, *discos*, disk). A genus of Diatoms.
Hydroids (Hydra-like). An order of Acalephs.
Hymenoptera (Gr. *humen*, membrane, *pteron*, wing). The membranous-winged insects; bees, wasps, ants, etc.
Hyphantria (Gr. *huphantria*, a weaver). A genus of the Moth family Bombycidæ.

Ianthina (Gr. *Ianthinos*, violet-colored). A genus of pelagic mollusca.
Ibex. A genus of Goats.
Icteridæ. The Blackbird family.
Idyia. A genus of Acalephs.
Iguanodon (Spanish *Iguana*, Gr. *odon*, tooth). A genus of reptiles.
Ilex. The Holly.
Ilium. One of the bones of the pelvis.
Imago. The perfect state of insects, in distinction from the larva or pupa state.
Impatiens. The Balsam, Jewell-weed.
Incrassated. Thickened.
Infusoria. Protozoa and other microscopic animals and plants generated in infusions of plants; commonly called *animalcules*.
Isöetes. Quillwort; an aquatic cryptogam.

Issus. A genus of the hemipterous family Cercopidæ.

Jatropha. The Spurge-nettle.
Juncus, pl. *Junci.* The Rush.
Jurassic. A geological formation.

Kjækkenmæddings, pronounced Kirk-ken-merdings. From the Danish; meaning kitchen-refuse.

Labium. The second pair of maxillæ of insects, consolidated into the piece forming the under lip of insects, and opposed to the labrum, or upper lip.
Lacustrine. Relating to a lake.
Lamna. A genus of Sharks.
Larva. The first stage of the young insect after hatching.
Lasiurus (Gr. *lasios*, hairy, *oura*, tail). A genus of Bats.
Laurentian. A geological formation, the oldest known, so-called from the St. Lawrence river.
Lemna. The Duck-weed.
Lepidoptera (Gr. *lepis*, scale, *pteron*, wing, scaly-winged). A suborder of insects; the butterflies and moths.
Léporides. The Hares.
Leptorine. Relating to the hares.
Lesleyite. A mineral named after Lesley.
Lespedeza. The Bush-clover.
Lestes. A genus of small Dragon-flies.
Libellula (L. *libella*, a little book). The Dragon-fly.
Licmophora. A genus of Diatoms.
Liliaceæ. The Lily family.
Limacodes (Gr. *limacodes*, herb-feeding). A genus of Bombycidæ, whose larva is slug-like.
Limnæa. A genus of fresh-water snails.
Limnanthaceæ. The Limnanthus family.
Linaria. The Wood-flax; a genus of the Fig-wort family.
Lindera. The Benzoin bush.
Lingual. Relating to the tongue.
Lingula (L. diminutive of *Lingua*, tongue). A genus of brachiopod shells. Also the name of a sub-formation of the Lower Silurian formation.
Linum. The Flax.
Liriodendron. The Tulip-tree.
Littorina (L. *Littus*, relating to the shore). A genus of Shells.
Lizzia. A genus of Acalephs.
Lobiform. Pad-like.
Loganiaceæ. Logania family of plants.
Lophobranchs. A group of fishes, embracing the Sea-horse, Pipe-fish, etc.
Lunule. A crescent-shaped area.
Lupus. The Wolf.
Lycæna (Gr. *lukaina*, she-wolf). A genus of butterflies.
Lycopods. The Club-mosses.
Lysianassa. A genus of "Beach-flea," Amphipod Crustacea.

Macropus (Gr. *macros*, large, *pous*, foot).
Macrosaurus (Gr. *macros*, large, *saurus*, reptile). A gigantic fossil Crocodile.
Mandible. The biting, chewing "jaws," or first pair of jaws of insects, corresponding to the jaw and teeth of vertebrate animals.
Mantispadæ. The Orthopterous family, so named from the typical genus Mantis, the Sooth-sayer insect.
Marsupials. The Pouched Mammals.
Maruta. The May-weed; a genus of the Composite family.
Matrix. A mould; the rock in which minerals are imbedded.
Maxilla. The lower jaw, applied also to the second pair of jaws of insects.
Medicago. The Medick. A genus of the Pulse family.
Medullary. Relating to the spinal marrow, or spinal cord.
Medusæ. The Jelly-fishes.
Megalichthys (Gr. *megas*, large, *ichthus*, fish). A reptile-like fish.
Megalosaurus (Gr. *megas*, large, *sauros*, reptile). A gigantic fossil reptile.
Megatherium (Gr. *megas*, large, *therion*, animal). A gigantic Sloth-like animal.
Melanerpes (Gr. *melas*, black, *herpes*, creeping). A genus of Woodpeckers.
Melanthaceæ. The Colchicum family.
Melecta (Gr. *meli*, honey, *lego*, to choose). A genus of Bees.
Melitæa. A genus of Butterflies.
Melosira. A genus of Diatoms.
Menobranchus (Gr. *menos*, strength, *bragchos*, gill). A genus of gilled salamanders.
Menopoma (Gr. *menos*, *poma*, operculum, door). A genus of Salamanders.
Mesozoic (Gr. *mesos*, middle, *zoōn*, animal). The middle division of geological formations, the *Palæozoic* being the oldest, and the *Cainozoic* the most recent group of geological periods.
Metamorphic. Relating to crystalline rocks altered from Sandstone, etc.
Metatarsal. Relating to the metatarsus, or bone of the instep, lying between the toes and tarsus, or heel.
Micrasterias (Gr. *micros*, small, *aster*, star). A genus of Desmids.
Millepora (L. *mille*, thousand, *porus*, pore, hole). A genus of Corals.
Miocene (Gr. *meion*, less, *kainos*, recent). The second division of the Tertiary epoch.
Modiola. The Horse-mussel.
Mollusca. From *mollis*, soft. The branch or sub-kingdom of Shell-fish, etc.
Monochromatic. Having but one color.
Monœcious. Having stamens or pistils only.
Monopetalous. When the corolla is composed of but one piece.
Morphology. The study of typical forms.
Mucedineæ. A group of minute fungi, moulds.
Mucor. A genus of minute fungi, or mould.
Multipartite. With many partitions.
Muscidæ. A family of Diptera, so called from the typical genus Musca.

Mycelial. Relating to the filaments from which mushrooms, etc., grow.
Mycetophilidæ. A family of Diptera, so called from the genus Mycetophila.
Myriapoda (Gr. *murios*, thousand, *pous*, foot). An order of Insects; the Centipedes, Galley-worms, Thousand-legs, etc.
Myrmica (Gr. *murmex*, ant). A genus of Ants.

Nareda. A genus of Nemertean worms: one of the smooth round worms.
Narthecium. The Bog-asphodel; a genus of the Lily family.
Nardosmia. Sweet Coltsfoot; a genus of the Composite family.
Nassa. A genus of Sea-shells.
Natatorial. Noting a Swimming-bird.
Natica. A genus of Sea-shells.
Navicula (L. diminutive of *navis*, a ship). A genus of Diatoms.
Neocæsariensis. Relating to New Jersey.
Nemertean, Nematoid. Relating to *nemertes*, a smooth round worm, lower than, but allied to the Earth-worm.
Nephroma. A genus of Plants.
Nereis. A Sea-nymph; a genus of worms.
Neuroptera (Gr. *neuron*, nerve, *pteron*, wing). The veiny-winged insects; Dragon-flies, Ephemera, etc.
Nitschia. A genus of Diatoms.
Noctilucæ (Gr. *nux*, night, *lu-ke*, light). A genus of phosphorescent protozoa.
Noctuidæ. A family of Moths; from the typical genus *Noctua*.
Notonecta (Gr. *notos*, back, *nektos*, swimming. A genus of aquatic Hemipters, which swim on their back.
Notodontidæ. A group of Moths belonging to the Bombycidæ.
Notommata. A genus of Rotifera.
Nymphæaceæ. The family of Water-lilies.
Nyssonidæ (Gr. *nusso*, to sting). A family of Wasps, so called from the typical genus *Nysson*.

Œdogonium. A genus of Confervæ.
Oldenlandia. The Houstonia, Innocence, Bluets. A genus of the Madder family.
Onagraceæ. The Evening Primrose family.
Onoclea. The Sensitive Fern.
Operculum (L. a door). The horny piece filling up the aperture of the shell after the animal has withdrawn.
Ophiuridæ. The Sand-stars; a family of Echinoderms.
Ophrys. An orchid.
Opthalmic. Relating to the eye.
Orbulina (L. diminutive of *Orbs*, a sphere). A genus of Foraminiferous shells.
Orobanche. The Squaw-root, the Cancer-root. A genus of the Broomrape family.
Orthis (Gr. *orthis*, straight). A genus of fossil Brachiopod shells.
Orthoptera (Gr. *orthis*, straight, *pteron*, wing). The straight-winged Insects. The Grasshoppers, etc.
Osmia (Gr. *osme*, odor). The Mason-bee.
Osmosis. The passage of fluids through membranes.
Otodus. A genus of Fishes.
Oxalis. The Wood-sorrel; a genus of the Oxalidaceæ, or Wood-sorrel family.

Pabulum (L. for food).
Pachydermata (Gr. *pachus*, thick, *derma*, skin). The thick-skinned mammals, Elephants, swine, etc.
Palæontologist. The student of fossils.
Palæozoic (Gr. *palaios*, ancient, *zoön*, animal-life). Applied to the oldest Fossiliferous rocks.
Palæoniscus. A genus of Fossil fishes.
Palimpsest. Parchment from which one writing has been erased to make room for another.
Paludina (L. *palus*, a swamp). A genus of fresh-water Shells.
Panorpina (Panorpidæ). A neuropterous family; so named from the typical genus Panorpa.
Paradoxides (Gr. *paradoxos*, paradoxical). One of the oldest genera of Trilobites.
Parenchyma. The soft cellular tissue of plants, like the green pulp of leaves.
Parnassiaceæ. The Parnassia family of plants.
Passiflora. The Passion-flower.
Patersonite. A mineral named after Paterson, a mineralogist.
Pathological. Relating to diseased parts of animals.
Paullinia. The Guarana plant.
Pecopteris. A genus of Ferns.
Pediculus. The Louse; a genus of bugs, Hemiptera.
Pelage. Fur, hair, skin of a wild beast.
Pellæa. The Cliff-brake.
Pelopæus. A genus of Mud-wasps.
Penicillium. A genus of microscopic Fungi.
Pentacrinus (Gr. *pentas*, five, *crinos*. A genus of Crinoids.
Pentandrous. Having five stamens.
Penthorum. Ditch-stone crop. A genus of the Saxifrage family.
Pentremites. A genus of Crinoids.
Periphery. The circumference of a circle.
Peripheral. Relating to Periphery.
Perlina (Perlidæ). A family of Neuroptera.
Permian. The name of a geological formation.
Petaloid. Petal-like.
Phænogamous. Relating to the Phanerogams, or Flowering-plants.
Phalanges. The Finger-bones.
Philampelus. A genus of Hawk-moths.
Phleum. A genus of Grasses.

Phymata (Gr. *phumatoo*, to swell). A genus of Hemiptera.
Phytocoris (Gr. *phuton*, plant, *koris*, bug), A genus of Hemiptera.
Physa. A genus of Fresh-water Snails.
Picus. A genus of Woodpeckers.
Pieris. A genus of Butterflies.
Pinus. The Pine-tree.
Pinnularia (L. diminutive of *pinna*, a wing). A genus of Diatoms.
Pisum. The Pea.
Placental. Relating to the placenta.
Platanthera. The False-orchis; a genus of the Orchis family.
Platycrinus (Gr. *platus*, broad, *krinos*, lily). A genus of Crinoids.
Pleurobrachia (Gr. *pleuros*, many, *brachion*, arm.) A genus of Jelly-fishes.
Pleistocene (Gr. *pleistos*, most, *kainos*, new). The newest strata of the Tertiary, or beginning of the present or Historic period. The Quarternary Epoch.
Pliocene (Gr. *pleion*, more, *kainos*, new). The newer tertiary, or third subdivision of the Tertiary.
Pleurosigma. A genus of Diatoms.
Plumule. The little bud, or first shoot of a germinating plantlet above the Cotyledons.
Pocillipora. A genus of Corals.
Podophyllum. The May-apple, Mandrake. A genus of the Barberry family.
Podosira. A genus of Diatoms.
Polemonium. The Greek Valerian.
Polioptila. A genus of Fly-catchers.
Polycystina (Gr. *polus*, many, *custis*, cyst, sac). Minute rhizopods bearing a silicious shell, ornamented with spines.
Polygamous. Having some perfect and some separated flowers, on the same or on different individuals, as the Red Maple.
Polypes, Polyps (Gr. *Polypus*). The Sea-anemonies, etc.; a class of Radiate animals.
Polypodium. A Fern. Polypody.
Polyzoön (Gr. *polus*, many, *zoön*, animal). A class of Mollusca.
Pompilus. A genus of Sand-wasps.
Porites. A genus of Corals.
Portulacœous. Relating to Portulaca. The Purselane.
Potamogeton. The Pond-weed.
Primordial. Earliest.
Prodrome. Forerunner.
Productus. A genus of fossil Brachiopods.
Pronated, Pronation. To turn the palm downward.
Protoplasm. The soft nitrogenous lining or contents of cells.
Protozoa (Gr. *protos*, first, *zoön*, animal). The simplest form of animal life, forming the fifth sub-kingdom of animals. The Sponge, Amœba.
Psocina, Psocidæ. The Neuropterous family, so called from Psocus.
Pteromali, Pteromalus. A genus of Chalcids.
Pteropods (Gr. *pteron*, wing, *pous*, feet). A group of pelagic gasteropodous mollusca, moving by wing-like expansions placed near the head.
Pulmonates. Breathing by lungs; applied to the air-breathing Snails.
Pupa. The Chrysalis, aurelia, or second stage in the transformation of insects.
Putorius. The Weasel.
Pulvinulina. A genus of Foraminifera.
Pyrrharctia (Gr. *pyrrhus*, red, *arctia*). A genus of Bombycidæ.
Pyrula. A genus of gasteropod shells.

Quarternary. The latest, or post-tertiary geological period, merging into the historic period.
Quercus. The genus of Oaks.

Racemes. A flower cluster, with one-flowered pedicels along the sides of a general peduncle, or stem.
Radicle. The stem part of the embryo, the lower end of which forms the root.
Ranatra (Gr. *ranter*, waterman). A genus of aquatic hemiptera.
Raphanus. The Radish.
Reduvius. A genus of Hemipterous insects.
Reticulation. Net-work.
Rhizodus (Gr. *rhiza*, root, *odos*, tooth). A genus of fossil fishes.
Rhombic. Like a rhomb.
Rotifera (L. *rota*, wheel, *fero*, to bear). The Wheel-animalcules; a group referred to the Crustacea, and also the Worms.
Rubiaceæ. The Madder family.

Sarcode (Gr. *sarx*, flesh, *derma*, skin). The jelly-like substance composing the bodies of Protozoa, corresponding to the flesh of the higher animals.
Sarcolemma. The sheath enveloping the muscular fibrillæ (little fibres).
Scapiocrinus. A genus of Crinoids.
Scelidosaurus. A fossil reptile.
Scoliidæ. A family of Wasps, so called from *Scolia*, the typical genus.
Scoria. Volcanic cinders.
Secondaries. Applied to the hind or second pair of wings of Lepidoptera.
Selandria. The Saw-fly; a genus of the Hymenopterous family Tenthredinidæ.
Selenosporium. A genus of minute fungi.
Semipalmated. Partially webbed.
Septum. A division.
Sequoia. The Redwood; a genus of Pines.
Seriolaria. A genus of Polyzoa.
Sialidæ, Sialina. A Neuropterous family, from Sialis, the typical genus.
Sigmoid. Like the letter S.
Silurian, from Silures; a race of ancient Welsh; applied to a geological formation.
Skier. A small island, islet.
Spat. The spawn of Shell-fish.
Spermatozoa, Spermatozoid. The male germ.
Sphingidæ. The family of Hawk-moths, from the genus Sphinx.

Sphegidæ. The family of Sand-wasps; from the genus Sphex.
Sphyrapici. A group of Woodpeckers.
Sphyræna. A genus of Fishes.
Spirifer (L. *spira*, spire, *fero*, to bear). A genus of fossil Brachiopod shells.
Spiracles. The breathing-holes of insects, through which air is conveyed into the body.
Sporangium. Spore-case.
Spore. The seed of Ferns, Mosses.
Sporular. Relating to a spore or sporule; a small spore.
Stauroneis (Gr. *stauros*, a cross, *neis*, a little boat). A genus of Diatoms.
Stelis. A genus of wild bees.
Sternite. The ventral piece forming the lower arch of the segment of an insect.
Stylet. A spine-like process, usually ending in a bristle.
Stylops. A genus of parasitic Beetles.
Supinate. To raise the palm upwards.
Surirella. A genus of Diatoms.
Syenite. Like granite, except that it contains hornblende instead of mica, as one of its three constituents.
Synchronize. To refer to the same age.
Synchronous. Of the same age.
Synedra. A genus of Diatoms.
Synthetic. Comprehensive; see p. 270.

Tabulate. Having a vertical row of plates.
Tachina. A genus of parasitic flies, like the House-fly.
Tarsus. The toe; in insects the terminal joint of the leg, divided into from two to five joints.
Tellurium. A metal.
Terebella. A genus of marine worms.
Terebratula (L. *terebra*, a gimblet). A genus of brachiopods.
Tergum. The "back" of insects; the upper part of the insect segment.
Tetrabranchiata. An order of Cephalopodous mollusca, such as the Nautilus, Ammonite, etc.
Tettigonia (Gr. *tettix*, cicida). A genus of Hemipterous insects.
Thalassicola (Gr. Sea-dweller). A group of gelatinous protozoa found floating in the sea.
Thecla. A genus of Butterflies.
Thomomys (Gr. *thomos*, heap, *mus*, mouse). A genus of Mice.
Thoracosaurus. A genus of fossil reptiles.
Tibia. The Shank-bone.
Tipulidæ. A Dipterous family; Daddy-long-legs.
Triassic. Relating to the Trias, or New-Red Sandstone formation.
Triceratium (Gr. *trias*, three, *keras*, horn). A genus of Diatoms.
Trilliaceæ. The Trillium family.
Trilobites. A group of extinct Crustacea allied to the Horse-shoe Crab, Limulus.
Trisetum. A genus of Grasses.
Tritonium (Gr. *triton*). A genus of marine shells.

Ulna. The larger and inner of the two bones of the fore-arm.
Umbels. An umbrella-like bunch of flowers.
Unionidæ. The Naiades; a family of fresh-water Mussels.
Urite. The abdominal sternum; (sternite.)
Utricle. A small, thin-walled, one-seeded fruit, as of Goosefoot.

Vascular. Relating to the blood-vessels.
Vesicular. Containing vesicles or cells.
Vespa. The Paper-wasp; a genus of the Vespidæ.
Vespertilio (L. *vesper*, evening). The Bat. A genus of the family Vespertilionidæ.
Vicia. The Vetch, Tare; a genus of the Pulse family.
Viola. The Violet.
Vitis. The Grape-vine.
Vitrina (L. *vitrea*, glassy). A genus of Land Snails.
Volvox (L. *volvo*). A genus of microscopic plants.
Vorticella (L. *vortex*). A genus of Protozoa.

Wolffia. A genus of the Duckweed family.

Xanthidium (*xanthion*, a burr). A genus of Desmids.
Xiphosura. A group of fossil Crustacea, allied to the Horse-shoe Crab.
Xylophagous. Wood-devouring.

Zeacrinus. A genus of Crinoids.
Zeolitic. Relating to the Zeolite family of minerals.
Zonites. A genus of fossil Land Snails.
Zoöspore (Gr. *zoön*, animal, *sporos*, seed). The male germ, or embryo of microscopic plants. See p. 224.